Do U.S. tariff reductions explain rising wage inequality?: The case of U.S. tariffs on imports from countries having free trade agreements with the U.S.

by

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To

My Parents, Eiko and Maiko

両親、英子、舞子に捧げる

Abstract

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The wage gap between skilled workers and unskilled workers expanded in the U.S. Based on the essential idea of Stolper and Samuelson (1941) and following the mandated wage method of Haskel and Slaughter (2003), this dissertation examines whether the reductions of U.S. import tariffs contributed to that expanding wage gap between the two types of workers in U.S. manufacturing industries during 1974-2004. I use U.S. tariffs on imports from countries having the free trade agreements with the U.S., which were in effect by 2004. They are U.S. tariffs on imports from Canada, Mexico, Israel, Chile, Jordan and Singapore. This dissertation did not find any significant evidence that U.S. tariff reductions expanded the wage inequality between skilled workers and unskilled workers in U.S. manufacturing industries during the period considered. This leads us to conclude that other forces must explain increasing U.S. wage inequality.

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Table of Content

I. Introduction

The wage gap between skilled workers and unskilled workers in U.S. manufacturing industries has widened since the early 1980s. Increasing wage inequality, especially in the U.S. has attracted economists' attention and many explanations have been offered. One of culprits most commonly cited is trade liberalization. The theory of international trade tells us that trade brings gains to a country. However, the theory of international trade and especially the Stolper-Samuelson theorem (1941) also tells us that there are winners and losers from international trade. If we replace wages and capital, which Stolper-Samuelson used in their theorem, with wages for skilled workers and wages for unskilled workers, the theorem says that the gains from international trade would be unevenly distributed among these two groups of workers, leading to increase in wage inequality. Since skilled workers in developed countries face relatively few foreign competitors, they may benefit from this trade liberalization. But, because unskilled workers in developed countries face severe import competition from low wage unskilled workers which are abundant in developing countries, international trade may hurt them. The theme of this dissertation is "Can trade liberalization explain the increasing wage inequality between skilled workers and unskilled workers in U.S. manufacturing industries?"

Several papers[1] have analyzed the relationship between trade liberalization and the rising wage inequality. But there is still considerable disagreement among

[1] Detailed literature review will be provided in the section II.

researchers about whether trade liberalization can explain the rising wage gap. The reason for the widening wage gap is not yet agreed upon. Some studies suggest that trade liberalization played a major role in increasing in wage inequality (Gaston and Trefler 1992, Leamer 1993, Brown, Deardorff and Stern 1993, Borjas and Ramey 1994, Feenstra and Hanson 1997, Borjas, Freeman and Katz 1997, Revenga and Montenegro 1998, Hanson and Harrison 1999, Robertson 2004). Some studies suggest that trade liberalization did not play a major role in rising wage inequality (Harrigan 2000, Haskel and Slaughter 2003, Trefler 2004). Some studies suggest that skill biased technological change is the major reason for the increasing wage inequality (Katz and Murphy 1992, Lawrence, Slaughter, Hall, Davis and Topel 1993, Berman, Bound and Griliches 1994, Haskel and Slaughter 1998, Katz and Author 1999). There are some studies which have uncertain conclusions (Leamer 1998, Feenstra and Hanson 1999, Baldwin and Cain 2000).

Different studies used different methods for the measurement of trade liberalization. Among studies which support the role of trade liberalization in the widening wage gap, Leamer (1993) and Borjas and Ramey (1994) used U.S. import volume, Feenstra and Hanson (1997) used foreign direct investment, Borjas, Freeman and Katz (1997) used immigration data, Gaston and Trefler (1992) and Brown et al (1993) used U.S. tariff rates to measure the effect of trade liberalization on the U.S. wage gap. Revenga and Montenegro (1998) and Hanson and Harrison (1999) used Mexican tariff rates and import-license coverage rate, and Robertson (2004) used product price changes in Mexico (he assumes that trade liberalization affects product prices) in order to analyze the effect of trade liberalization on the wage gap in Mexico. Among studies which did not find that trade liberalization contributed to a wage gap, including studies with uncertain conclusions, Harrigan (2000) used U.S. import prices, Leamer (1998) and Baldwin and Cain (2000) used product price changes (they assume that trade liberalization affects product prices), Feenstra and Hanson (1999) used a measure of foreign outsourcing and Haskel and Slaughter (2003) used U.S. tariff reductions to analyze the effect of trade liberalization on the U.S. wage gap. Trefler (2004) used both U.S. and Canadian tariff reductions to analyze the effect of trade liberalization on the wage gap in Canada.

There is little literature using U.S. tariffs for the measurement of trade liberalization in order to analyze the rising U.S. wage gap. Therefore, this dissertation focuses on U.S. tariff reductions to measure trade liberalization. Among those studies which have analyzed the relationship between U.S. tariff reductions and wage inequality, most used a weighted average of U.S. tariff on imports from all countries in the world. In this dissertation, I focus on the reduction of U.S. tariff rates on imports from countries having free trade agreements (FTAs) with the U.S. which were in effect by 2004. They are U.S. tariffs on imports from Canada, Mexico, Israel, Chile, Jordan and Singapore (FTA countries). Why am I interested in FTAs? First, there are no past studies which analyzed the effect of U.S. tariffs on imports from FTA countries on the rising wage gap in the U.S. Second, U.S. FTAs have provided us with the opportunity to observe the effect of significant U.S. tariff reductions[2].

[2] See the section IV for more details about movement of U.S. tariff rates.

Tariff rates were generally declining during 1974-2004 in the U.S. The average U.S. tariff rate on imports from all countries declined at an average annual rate of 3.2% during 1974-2004 while the average U.S. tariff rate on imports from FTA countries fell at an average annual rate of about 10%. Furthermore, the decline of tariff rates on imports from FTA countries accelerated sharply with the free trade agreements and became close to zero.

Meanwhile, the wage gap in the U.S. has been widening since the early 1980s[3]. During 1974-2004, the average real wage of skilled workers increased by about 10.9% while the average real wage of unskilled workers increased by only 3.5%, resulting in a significant increase in the relative wage of skilled workers.

I wonder if there is some significant relationship between rising U.S. wage gap and declining U.S. tariff rate. This is the motivation of this dissertation. Unlike the past studies listed above, I consider the essential idea of Stolper-Samuelson (1941) that the effect of trade liberalization (U.S. tariff reductions) on factor prices (wages for skilled workers and unskilled workers) works through changing product prices. To implement this idea, I apply the mandated wage methodology with the two-stage procedure[4] of Haskel and Slaughter (2003). That is, I first estimate the relationship between changes in product prices and changes in U.S. tariffs and other causal variables. I then estimate the change in wages affected by the change in tariff induced product prices.

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[3] See the section IV for more details about movement of wage gap between skilled workers and unskilled workers.

[4] It is first proposed by Feenstra and Hanson (1999).

For data, I use Annual Survey of Manufactures (ASM) for all U.S. manufacturing industries described by four-digit SIC 72 (1974-1986), four-digit SIC 87 (1987-1996), six-digit NAICS (1997-2001) and six-digit NAICS based code (2002-2004). I use import data from Feenstra (1996) based on the Tariff Schedule of the United States Annotated (TSUSA) classification code for 1974-1988, from Feenstra, Romalis and Schott (2002) based on ten-digit Harmonized Tariff System (HTS) code for 1989-2001, and from the Bureau of the Census based on HTS code for 2002-2004. The data consist of the U.S. import variables from all countries and U.S. industrial variables during 1974-2004, all of which are aggregated into 100 industries for concordance.

This dissertation, using U.S. tariffs on imports from FTA countries, examines whether U.S. tariff reductions contributed to the increasing wage gap between skilled workers and unskilled workers in U.S. manufacturing industries during 1974-2004. I conduct three sets of estimations. First, I estimate the individual effect of U.S. tariff reductions on imports from FTA countries during 1974-2004. I estimate two combined effects of (i) U.S. tariff reductions on imports from both Canada and Mexico, and (ii) those on imports from 6 FTA countries, on wages for both types of workers during the same period (1974-2004). Second, I divide the entire periods of 1974-2004 into two periods, one before FTA starts (pre FTA period) and another after FTA starts (post FTA period). I then estimate the individual effects (mentioned in the "First" part) during the pre FTA period and during the post FTA period. These estimates give us how the effect of U.S. tariff reductions on the wage gap changes between the two periods. Third, I estimate the effect of U.S. tariffs on imports from all countries in the world during 1974-2004. This dissertation applies the method of Haskel and Slaughter (2003) and examines whether U.S. tariff reductions contribute to the rising wage gap in the U.S., as they do. So, this third analysis is for the purpose of comparison between Haskel and Slaughter (2003) and this work. My emphasis is on U.S. tariffs on "FTA countries" rather than on all countries in the world.[5]

The main findings are as follows. First, I estimated that U.S. tariff reductions on imports from Canada, Mexico, Israel and Singapore, working through product price changes, mandated a fall in the wage gap in U.S. manufacturing industries during 1974-2004. On the other hand, U.S. tariff reductions on imports from Jordan and Chile mandated a rise in the wage gap during the same period. However, in all cases the effects are not statistically significantly different from zero. Second, our estimates indicate that the combined effect of U.S. tariff reductions on imports from Canada and Mexico was to raise the wage gap in U.S. manufacturing industries during 1974-2004. I obtained the same result for the combined effect of U.S. tariffs on goods from all 6 FTA countries. However, all of these effects are not statistically significantly different from zero. Third, the same insignificant results were obtained when I estimated each individual effect during the pre FTA period and during the post FTA period. All of these results indicate that U.S. tariff reductions on imports from FTA countries did not have any statistically significant effects on mandated changes in the wage gap in U.S. manufacturing industries during the periods considered.

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[5] See the section II for more details about comparison between Haskel and Slaughter (2003) and this dissertation.

Finally, when I estimated the effect of U.S. tariffs on imports from all countries in the world, I did not obtain any significant evidence that U.S. tariff reduction raised the wage gap in the U.S. This result is consistent with Haskel and Slaughter (2003). Thus, this dissertation does not find any significant evidence that U.S. tariff reductions expanded wage inequality between skilled workers and unskilled workers. These results lead us to conclude that other forces must explain rising wage inequality in the U.S.

The remainder of this dissertation is organized as follows. In the next section, I will review past literature, which includes a comparison of this work with Haskel and Slaughter (2003) and other major studies. Section III summarizes the recent movement of trade liberalization. Section IV reviews the tariff and wage data. Section V describes the empirical research methodology and explains the models which I used. Section VI describes the construction of data set that I used for this work. Section VII explains specifications of mandated wage regression with two-stage procedure which I run for this work. Section VIII provides all results which I estimated. Section IX gives a summery of the results and a discussion of robustness checks. Finally, Section X concludes the dissertation.

II. Literature review

A. Descriptive of literature

I will review past literature listed in the previous section as follows.

A – 1. Studies suggesting that trade liberalization had a major role in the increase in the wage inequality

Gaston and Trefler (1992) used Current Population Survey (CPS) for most of the industrial data, the 1983 GATT tariff schedule, and the 1983 UNCTAD data base on trade control measures for trade protection data to examine the effect of the reduction of trade barriers on wages in U.S. manufacturing industries in 1983. They found that wages were negatively correlated with tariffs. Leamer (1993), using NBER Manufacturing Productivity Database (Bartelsman and Gray 1996) for 1972-1985, estimated the effect of the U.S.-Mexico FTA on the change of wages for professional/technical workers and other workers, and on the rental price of capital in the U.S. He estimated the effect of U.S. import volume on the change of wages and that of rental price of capital to conclude that the U.S.-Mexico FTA caused a substantial increase in Mexico's exports to the U.S. resulting in a substantial rise in wages for professional/technical workers and decline in wages for other workers in the U.S. Brown et al (1993), using a computable general equilibrium (CGE) model, estimated the effect of NAFTA (measured by the change of tariffs) on wages and the rental price of capital in all three NAFTA countries. They found that NAFTA would raise the real wage of workers for all three countries. Borjas and Ramey (1994) found that increased international competition (measured by U.S. import volume) explained much of increase in wage inequality. Feenstra and Hanson (1997) examined the effect of foreign direct investment (FDI) on relative demand of skilled labor in Mexico and found that FDI played an important role for the relative wage of skilled workers. Borjas, Freeman and Katz (1997), using immigration data, estimated that 40 % of the increase in the relative wage of all other workers to high school dropouts could be attributed to the increased relative supply of high school dropouts from immigration, leading to the increase in wage gap between two types of workers. Revenga and Montenegro (1998) analyzed the effect of trade liberalization (measured by tariff rates and import-license coverage rate) in Mexico on U.S.-Mexico wage differentials during 1984-1990 and found that the wage differentials were positively correlated with Mexican tariff rates and import license coverage rate. Hanson and Harrison (1999), using reduction of Mexican tariff rates and import-license coverage rate during 1984-1990, found that trade reform-import competition from developing countries having abundant unskilled labor, such as China, contributed to an increase in skill intensity (more demand in skill intensive industry), resulting in an expansion of the wage gap. Robertson (2004), assuming that trade liberalization affects product prices, analyzed the relation between change in product prices and change in wage inequality during 1987-1999 (period after Mexico entered GATT and NAFTA). He found that relative price of skilled worker intensive goods rose and the relative wage for skilled workers rose following entrance to GATT in 1986 and the relative wage of skilled workers fell after NAFTA.

A – 2. Studies suggesting that trade liberalization does not have major role on the wage inequality

Harrigan (2000) analyzed the role of U.S. import prices on wages during 1967-1995 and found that the direct impact of import prices on wage was negligible. Trefler (2004), using U.S. and Canadian trade data and manufacturing data during 1980-1996, estimated the effect of the change in tariffs and other economic variables on the change in employment and labor productivity in Canada for two periods; 1980-1986 for pre Canada-U.S. FTA and 1988-1996 for post Canada-U.S. FTA. He found that the Canada-U.S. FTA lowered substantial employment in Canada, led to large labor productivity gains in Canada, lowered Canadian import prices, and created more Canadian trade with the rest of the world. He also found that there was no evidence that tariff reductions under the Canada-U.S. FTA worsened income inequality between the two types of workers in Canada.

A – 3. Studies suggesting that skill biased technological change is the major reason for the widening wage gap

Katz and Murphy (1992) analyzed relative wage movement during 1963-1987 using a labor market supply-demand framework to find that rapid growth in the relative demand for more skilled workers was a key for rising wage inequality. Lawrence, Slaughter, Hall, Davis and Topel (1993) found that the relative wage in the U.S. has not been driven by Stolper-Samuelson effect but by technological changes. Berman, Bound and Griliches (1994) analyzed the shift in demand from unskilled toward skilled workers and found skill biased technological change was a main explanation for this shift. Haskel and Slaughter (1998) provided empirical evidence for the proposition that rising (falling) skill premiums were caused by more extensive skill biased technological change in skill intensive (unskilled intensive) sectors by finding a strong correlation between changes in skill premium and sectoral bias of skill biased technological change during 1970s and 1980s in U.S. and U.K. Katz and Author (1999) found that substantial increases in the relative demand for more educated and more skilled workers explained the evolution of the wage structure and within industry skill upgrading was the major driving force in the rise in the relative demand for the most skilled. This led to the conclusion that skill-biased technological change was more important than international trade in explaining the widening wage gap.

A – 4. Studies that have uncertain conclusions

Leamer (1998) examined the effect of product price changes on wages under the assumption that trade liberalization affects product prices. He found the decline in relative price of unskilled labor intensive product widened wage inequality during 1970s and mandated declines in wage inequality during 1980s. Feenstra and Hanson (1999) estimated the impact of foreign outsourcing (calculated as the share of imported intermediate inputs in total costs) and shifting toward high tech capital (calculated as the share of high-technology capital in the total capital stock), such as computer, on wages during 1979-1990. They used two different methods and obtained two different results. Using a conventional price regression model, they found that foreign outsourcing explained little of the wage inequality and shifting to high tech capital explained most of the wage gap. But when they use a different two-stage price regression model, they obtained the opposite result. Baldwin and Cain (2000), assuming trade liberalization affects product prices, used product price changes during 1979-1996 in the U.S. and were unable to support either the conclusion that increased import competition was the main force causing the increase in wage inequality in 1980s and 1990s, or the conclusion that increased import competition had a negligible effect on the relative wage.

B. Comparison of my work with the literature

B – 1. Comparison with Haskel and Slaughter (2003)

This dissertation applies the method of Haskel and Slaughter (2003) and has a purpose similar to theirs[6]. Haskel and Slaughter (2003), using tariff data from Magee (1998), transportation cost data from Feenstra (1996) and other data from the NBER Productivity Database (Bartelsman and Gray 1996), analyzed the effect of the change in product prices induced by the change in U.S. tariffs and transportation costs on wages during 1974-1988 in manufacturing industries in the U.S. They found that the change in product prices induced by tariff and transportation costs mandated a rise in the skill premium. But this result was not statistically significantly different from zero, and thus did not conclude product price changes induced by falling tariffs and transportation costs mandated a rise in wage inequality in the U.S.

This dissertation used the two-stage mandated wage methodology of Haskel and Slaughter (2003) and has not obtained any significant effects of U.S. tariff reductions on the wage gap between skilled and unskilled workers in the U.S. The differences between the two are as follows. First, Haskel and Slaughter (2003) estimated the effect of the weighted average of the U.S. tariff rates on imports from all countries in the world on change in wages. I estimated the effect of U.S. tariff rates on imports from 6 FTA countries (Canada, Mexico, Israel, Jordan, Chile and Singapore). Second,

[6] Haskel and Slaughter conducted the same analysis for U.K as well in Haskel and Slaughter (2001).

Haskel and Slaughter (2003) conducted the analysis from 1974 to 1988. I expanded the period for the analysis to 2004, that is, 1974-2004 for 31 years. Third, Haskel and Slaughter (2003) took the difference between the U.S. tariff rate in the initial year and that in the end year to calculate the change in tariff rate. I took the difference of the U.S. tariff rate every year for 31 years (1974-2004). Fourth, Haskel and Slaughter (2003) used the method of Feenstra and Hanson (1997) to correct estimated variances of estimated coefficient in the second-stage regression. I used the method of Dumont, Rayp, Thas and Willeme (2005) to guarantee positive variances. Fifth, Haskel and Slaughter (2003) used tariff data from Magee (1998), other import data from Feenstra (1996) and industrial data from the NBER Productivity Database (Bartelsman and Gray 1996). All of their data are described by SIC 72. I used ASM for all U.S. manufacturing industries described by four-digit SIC 72 (1974-1986), four-digit SIC 87 (1987-1996), six-digit NAICS (1997-2001) and six-digit NAICS based code (2002-2004). I used import data from Feenstra (1996) based on TSUSA classification code for 1974-1988, from Feenstra et al (2002) based on ten-digit HTS code for 1989-2001, and from the Bureau of the Census based on HTS code for 2002-2004. All of data are aggregated into 100 industries for concordance.

B – 2. Comparison with other studies

My results are also consistent with those of Harrigan (2000) and Trefler (2004), who found no significant evidence that tariff reductions widened wage gap. Hariggan (2000) used U.S. import prices and a general equilibrium model to analyze the effect of trade liberalization on the U.S. wage gap. Trefler (2004) analyzed the effect of tariffs on the wage gap for Canada but not for the U.S.

My results are not consistent with some studies that suggest that trade liberalization has a major impact on the wage gap and that give uncertain conclusions. A couple of reasons for this difference could be considered. First, different variables are used to measure trade liberalization: Leamer (1998) and Baldwin and Cain (2000) used product price changes assuming trade liberalization affects product prices, Leamer (1993) and Borjas and Ramey (1994) used U.S. import volume, Feenstra and Hanson (1997) used foreign direct investment, Borjas, Freeman and Katz (1997) used number of immigrants, Feenstra and Hanson (1999) used foreign outsourcing, and Gaston and Trefler (1992) and Brown et al (1993) used tariff reductions. I used tariff induced product price changes, which shows what share of price variation is due to tariff changes. A second reason for the different results between my results and the other results is the different regression method employed. Other studies which found that trade liberalization had an impact on the wage gap employed a conventional regression to estimate, for example, the direct relation between product prices and wage gap. I used a two-stage procedure to estimate the relationship between tariff rates induced product price change and wage gap. Third, the following studies estimated the effects of trade liberalization in Mexico on Mexican wages, not the effect of U.S. tariff reductions on U.S. wages: Revenga and Montenegro (1998) and Hanson and Harrison (1999) used Mexican tariff rates and import-license coverage rate, and Robertson (2004) used product price changes (they assume trade liberalization affects product prices) in order to analyze the labor market in Mexico.

III. Movement of trade liberalization

The movement of trade liberalization has spread widely around the world. The General Agreement on Tariffs and Trade (GATT), which was set up after World War II and developed into the World Trade Organization (WTO) in 1994, along with the International Monetary Fund (IMF), the World Bank, and other international institutions, has brought several "rounds" (Uruguay, Tokyo, and Doha) of trade barrier reductions. GATT is built on a foundation of multilateral reductions in trade barriers based on the principle, stated in the Article I, that all countries belonging to the GATT should be treated equally (Feenstra 2004). However there has been a separate movement toward regional or preferential reductions in trade barriers. These regional agreements or preferential agreements call for a "common effective preferential tariff" (CEPT), under which a group of countries eliminate all tariffs between themselves, without eliminating tariffs on goods imported from the rest of the world. Although these agreements violate the principle of Article I of GATT, they are permitted under Article XXIV (Feestra 2004). A group of countries, which unifies their tariffs on the rest of world, with zero tariffs internally, is called a customs union. Examples include the European Economic Community (EEC), MERCOSUR which involves Argentina, Brazil, Paraguay and Uruguay. An agreement by a group of countries to maintain their own tariffs on the rest of the world, with zero tariffs internally is called a free trade agreement (FTA) and the group of countries is called a free trade area. The movement toward a free trade agreement (area) started in the late 1980s mainly in North America and Europe. Since 2000, it has spread to East Asia and South America. For example, the U.S. has concluded FTAs with Israel, Canada, Mexico, Jordan, Chile, Singapore, Australia, Peru, and South Korea. Japan has agreements with Singapore and ASEAN. China has an agreement with ASEAN (Urata and Kiyota 2003, Whalley and Leith 2003, Banda and Whalley 2005). In Europe, we have the European Free Trade Agreement which involves Iceland, Liechtenstein, Norway, and Switzerland. South East Asian countries have concluded ASEAN Free Trade Area, which involves Singapore, Malaysia, Thailand, Indonesia, Philippine, Brunei, Vietnam, Laos, Myanmar, and Cambodia. There is a widespread movement toward the reduction or elimination of policy imposed trade barriers. In the U.S., heated debates were generated when the U.S.-Mexico FTA was set on the table for negotiation and the planning for North American Free Trade Agreement (NAFTA) was underway. There are many people who still remember the presidential debates in 1992, where Ross Perot claimed that NAFTA would generate "a giant sucking sound" with high wages and challenging jobs fleeing to Mexico (Lawrence, Slaughter, Hall, Davis and Topel 1993).

IV. Summary of data for U.S. tariffs and wages

I use tariff data on U.S. imports from Feenstra (1996) for 1974-1988, from Feenstra et al (2002) for 1989-2004 and from the Bureau of the Census for 2002-2004. The tariff rate for a given commodity is calculated as total duties collected as a share of the total customs value of imports for consumption. Here, in order to get a general picture of the changing tariff climate, I will present average tariff rates. The weighted average[7] of U.S. tariff on imports from all countries in the world declined from about 5% to about 2% in 2000 and has remained there since then, as shown in Figure 1. U.S. tariff rates on imports from all countries in the world declined by 3.2% on average annually. Meanwhile, U.S. tariffs on imports on the 6 FTA countries, that is, Canada, Mexico, Israel, Jordan, Chile and Singapore, were generally declining during 1974-2004 period as can be seen in Figure 2 to Figure 7. The U.S. tariff rate on imports from each FTA country fell by about 10% on average annually. Furthermore, we see that the decline of tariff rates with each FTA country accelerated sharply with the FTA and the tariff rates became close to zero % around 2000 and have remained there since then. These sharp declines of tariff rates after the beginning of the FTAs can be seen more clearly in Table 1.

Wage data for both skilled workers and unskilled workers comes from ASM during 1974-2004. I use production workers for unskilled workers and non-production workers (total workers minus production workers) for skilled workers. All nominal wages are converted to 1982-1984 dollars using the CPI for all urban consumers (CPI-U). Here I will look at average wages. Figure 8 summarizes the overall movement of real wages for skilled workers and unskilled workers in U.S. manufacturing industries during 1974-2004. There was generally an upward trend since the early 1980s for real wage of skilled workers while no general trend could be seen for unskilled workers. From 1974 to 2004, the average real wage of skilled

[7] The weighted average of tariff rates are calculated as total duties collected as a share of total custom value of imports for consumption. See section VII for more details.

workers increased by about 10.9% while the average real wage of unskilled workers increased only by 3.5%, resulting in a significant increase in the relative wage of skilled workers, as seen in Figure 9. Note that the increase in the relative wage of skilled workers was sharpest between 1980 and 2000 and has declined between 2000 and 2004[8].

V. Empirical research methodology – Model

I apply the mandated wage methodology[9] of Haskel and Slaughter (2003). Let $i = 1,.........., I$ be a factor of production and $j = 1,.........., J$ be an industry. I assume that: (i) technology is characterized by constant returns to scale, (ii) there is full employment of factors, and each factor is perfectly mobile within the country but immobile across countries, and (iii) there is perfect competition. Then, in equilibrium, there are zero profits:

$$p = A^T w \qquad (1)$$

where p is J x 1 vector of product prices, w is I x 1 vector of factor prices, and A^T is J x I technology matrix, whose a_{ij} element is the number of units of factor i required to produce one unit of product j (Letting c_j is a unit cost function for commodity j, we have $a_{ij} = \frac{\partial c_j}{\partial w_i}$).

(1) may be written as

$$p_j = \sum_{i=1}^{I} a_{ij} w_i \qquad j = 1,.........., J \qquad (2)$$

[8] Relative wage of skilled workers to unskilled workers rose in 2005 again.
[9] See Appendix I for more details about mandated wage methodology.

Total differentiation of (2) yields

$$\hat{p}_j = \sum_{i=1}^{I} \theta_{ij} \hat{w}_i + \sum_{i=1}^{I} \theta_{ij} \hat{a}_{ij} \qquad j = 1, \ldots\ldots\ldots, J \quad (3)$$

where, ^ (hat) means percentage change denoted by $\hat{p} = \frac{dp}{p} = d(\log p) = \%$ change in p from Jones algebra (Jones 1965). $\hat{p}$ is J x 1 vector of J product price changes, $\hat{w}$ is I x 1 vector of I factor price changes, and θ is J x I matrix showing share of factor among unit cost, whose ij element (θ_{ij}) is the share of factor i in the average cost incurred to produce one unit of product J, that is, $\theta_{ij} = \frac{a_{ij} w_i}{p_j}$, where $a_{ij} = \frac{\partial c_j}{\partial w_i}$ is the amount of factor i required to produce one unit of commodity J.

From the full employment condition,

$$AY = V \qquad (4)$$

where, A is I x J technology matrix, whose a_{ij} element is the number of units of factor i required to produce one unit of product j, Y is J x 1 vector of J outputs of commodities, and V is I x 1 vector of endowment of factors of production.

(4) will be rewritten in the form for i^{th} factor and j^{th} commodity as

$$a_{ij} Y_j = V_{ij} \quad (5)$$

Total differentiation of (5) gives

$$\hat{a}_{ij} + \hat{Y}_j = \hat{V}_{ij} \quad (6)$$

Standard measurement of total factor productivity (TFP) (Oulton and O'Mahony 1994, Leamer 1998, Haskel and Slaughter 2001) is given in the form for j^{th} commodity by

$$TFP_j = \frac{Y_j}{\sum_{i=1}^{I} \theta_{ij} V_{ij}} \qquad J = 1, ..., J \quad (7)$$

Total differentiation of (7) gives

$$\begin{aligned}
T\hat{F}P_j &= \hat{Y}_j - \sum_{i=1}^{I} \theta_{ij} \hat{V}_{ij} \\
&= \hat{Y}_j - \sum_{i=1}^{I} \theta_{ij} (\hat{a}_{ij} + \hat{Y}_j) \qquad \text{(from (6))} \\
&= \hat{Y}_j - \sum_{i=1}^{I} \theta_{ij} \hat{a}_{ij} - \sum_{i=1}^{I} \theta_{ij} \hat{Y}_j \\
&= -\sum_{i=1}^{I} \theta_{ij} \hat{a}_{ij} \quad (\text{since } \sum_{i=1}^{I} \theta_{ij} = 1), \quad J = 1, ..., J \quad (8)
\end{aligned}$$

By plugging (8) into (3), we get

$$\hat{p}_j = \sum_{i=1}^{I} \theta_{ij} \hat{w}_i - T\hat{F}P_j \qquad j = 1, ..., J$$

$$\text{or} \qquad \hat{p} = \theta \hat{w} - T\hat{F}P \qquad (9)$$

where, $\hat{p}$ is a J x 1 vector of percentage changes in product prices, $\hat{w}$ is an I x 1 vector of percentage changes in factor prices, and θ is a J x I matrix of factor cost shares. That is, θ_{ij} = the share of factor i in the average cost incurred to produce one unit of product j = $\frac{a_{ij} w_i}{p_j}$, where $a_{ij} = \frac{\partial c_j}{\partial w_i}$ is the amount of factor i required to produce one unit of commodity j. $T\hat{F}P$ is a J x 1 vector of growth in total factor productivity and TFP_j is defined by:

$TFP_j = \dfrac{\text{amount of total value added for industry j}}{(\text{cost share for industry j})\, x\, (\text{total endowment of factor i})}$, following Leamer (1998). Equation (9) shows how the factor prices adjust to changes in product prices or technology to restore the zero profit condition in all industries. In other words, a regression of $\hat{p}_j$ on the factor shares θ_{ij} yields estimates of percentage changes in factor prices under the zero profit condition assuming unchanged technological conditions (TFP).

Unlike some of past studies analyzing the relationship between tariffs and wages, this dissertation considers the essential idea of Stolper and Samuelson (1941) that the effect of trade liberalization on real factor prices works through changing product prices. The traditional Heckscher-Ohlin theory of international trade is stated in terms of an economy with no trade barriers for which domestic product prices are set in world markets. Trade barriers drive a wedge between domestic prices and world prices. I focus on the reduction of tariff rates as one form of trade liberalization and examine the effect of product price changes mandated by U.S. tariff reductions on wages for skilled workers and unskilled workers. To implement this, I apply the two-stage mandated wage methodology of Haskel and Slaughter (2003).

Suppose there is a list of K variables which affect product prices $(k = 1, ..., K)$. This list will include tariff rates as well as other causal variables such as transportation costs, U.S. output share, exchange rate, capital/labor ratio, and

TFP. Let the time period be $t = 1, ..., T$. $\hat{p}$ is (J x T) x 1 vector of percentage changes of domestic product prices. Let Z_j be the T x K matrix consisting of elements z_{jtk} = value of the k^{th} causal variable for sector j at time t. So, $Z = \left(Z_1, Z_2, ..., Z_j\right)^T$, a (J x T) x K matrix of causal variables, which are assumed to drive product price changes. Let α, a parameter to be estimated with K x 1 matrix be the effect of a one percent change in causal variable Z on $\hat{p}$.

First, I regress the percentage change in product prices on changes in tariff rates and other causal variables Z, and estimate the relationship between the change in product prices and the change in tariffs. This allows me to estimate the effect of changes in tariff rates on product prices.

$$\hat{p} = Z\alpha + D\lambda + \varepsilon \qquad (10) \text{ ----- first-stage regression}$$

Here ε is an error term with (J x T) x 1 vector. Estimated coefficients $\tilde{\alpha}$ show how much the change in causal variables affects the change in product prices (an estimate of the portion of the percentage change in product prices due to the change in causal variables). $\tilde{\alpha}$ does not vary by industry. This assumes the same pass-through rate from tariff to product price changes across all industries, that is, all industries are treated identically. To allow heterogeneity among industries, I include industry dummy variables D in equation (10). D is (J x T) x K diagonal matrix with T x 1 column of ones in each diagonal position. λ is an estimated coefficient of D with K x 1 vector.

Second, I regress the contribution to $\hat{p}$ of each causal variable, $Z\tilde{\alpha}$ obtained from the first-stage regression (10), on the factor share θ to estimate the percentage change in factor prices affected by the change in tariff induced product prices:

$$Z\tilde{\alpha} = \theta\beta + D\gamma + e \qquad (11) \text{ ----- second-stage regression}$$

where, $Z\tilde{\alpha}$ is (J x T) x 1 vector, θ is (J x T) x I matrix of factor share among the cost, β is a parameter to be estimated with I x 1 vector, and e is a (J x T) x 1 vector of error terms. D, dummy variable with (J x T) x K diagonal matrix, is included in equation (11) with the same reason for equation (10). γ is an estimated coefficient of D with K x 1 vector. The second-stage regression yields $\tilde{\beta}$ (estimates of β), the percentage change in factor prices mandated by each causal variable working through $\hat{p}$. That is, I have an estimate of the effect on the percent change in factor prices of the change in product prices which are mandated by the reduction of tariffs. Suppose $\tilde{\beta}_s$ is the percentage change in the wage for skilled workers and $\tilde{\beta}_u$ is the percentage change in the wage for unskilled workers, both of which result from a one percent change in tariffs. The difference between $\tilde{\beta}_s$ and $\tilde{\beta}_u$ tells us how the change in tariff affects the wage gap.

The dependent variable in the second-stage regression (11) is generated from estimates of the first-stage regression. While the estimated coefficient for the second-stage regression is still consistent (Murphy and Topel 1985), the standard error of the second-stage coefficient estimates needs to be corrected to account for the additional variance of the first-stage estimation. I have followed the procedure proposed by

Dumont, Rayp, Thas, and Willeme (2005)[10] to correct the variance of the second-stage regression coefficient estimates. That is,

First-stage regression: $\hat{p} = Z\alpha + \varepsilon$ (10)

Second-stage regression: $Z\tilde{\alpha} = \theta\beta + e$ (11)

Then[11], $Var\left(\tilde{\beta}\right) = \sigma_e^2\left(\theta^T\theta\right)^{-1} + \left(\theta^T\theta\right)^{-1}\theta^T Z\Omega Z^T\theta\left(\theta^T\theta\right)^{-1}$

$$= \left(\theta^T\theta\right)^{-1}\left[\theta^T\sigma_e^2\theta + \theta^T Z\Omega Z^T\theta\right]\left(\theta^T\theta\right)^{-1},$$

where $\Omega = \sigma_e^2\left(Z^T Z\right)^{-1}$.

σ_e^2 can be estimated by $\dfrac{u^T u}{n-v}$, where u is estimated residual from the second-stage stage regression, v is number of columns of θ ($v = 3$ if I use three factors of production), and n is number of observations. Ω is estimated by $\tilde{\Omega}$, covariance matrix of $\tilde{\alpha}$, which is unbiased estimator of Ω obtained from the first-stage regression.

VI. Data

A. Data source

This analysis uses U.S. industry data and import data for 1974-2004 since data for duties from import data is not available before 1974. U.S. industrial data is provided by Annual Survey of Manufactures (ASM) with four-digit 1972 Standard

[10] Dumont et al (2005) improved the correction procedure developed first by Feenstra and Hanson (1997).

[11] See Feenstra and Hanson (1997) and Dumont et al (2005) for this result.

Industrial Classification (SIC 72) code for 1974-1986, ASM with four-digit 1987 Standard Industrial Classification (SIC 87) code for 1987-1996, ASM with six-digit North American Industrial Classification System (NAICS) code for 1997-2001, and ASM with six-digit NAICS based code (ASM-CODE) for 2002-2004. ASM is provided by US Census Bureau. Import data is available from Feenstra (1996) based on Tariff Schedule of the United States Annotated (TSUSA) classification code for 1974-1988, from Feenstra, Romalis and Schott (2002) based on ten-digit Harmonized Tariff System (HTS) code for 1989-2001, and from the Bureau of the Census based on HTS code for 2002-2004. All nominal variables are converted to 1982-1984 dollars using CPI for all urban consumers (CPI-U).

B. Consistent industrial classification code (ASM-HK)

All industrial data and import data are aggregated into 100 industries for concordance. Because industrial classification code used in each data above is different and ASM-CODE has the least number of manufacturing industries among 6 classification codes (TSUSA: about 27,000 industries for all industries, HTS 10: about 24,000 industries for all industries, SIC 72: 450 manufacturing industries, SIC 87: 460 manufacturing industries, NAICS: 473 manufacturing industries, ASM-CODE: 322 manufacturing industries), I, using the following concordance,

(a) Concordance between TSUSA and SIC 72 (Feenstra 1996)

(b) Concordance between SIC 72 and SIC 87 (US Cencus Bureau)

(c) Concordance between HTS and SIC 87 (Feenstra et al 2002)

(d) Concordance between SIC 87 and NAICS (US Census Bureau)

(e) Concordance between NAICS and ASM-CODE (ASM 2004, US Census Bureau)

first tried to replace industrial classification code of each data with ASM-CODE as follows:

Industry data:

1974 – 1986: SIC 72 $\overset{(b)}{\rightarrow}$ SIC 87 $\overset{(d)}{\rightarrow}$ NAICS $\overset{(e)}{\rightarrow}$ ASM-CODE

1987 – 1996: SIC 87 $\overset{(d)}{\rightarrow}$ NAICS $\overset{(e)}{\rightarrow}$ ASM-CODE

1997 – 2001: NAICS $\overset{(e)}{\rightarrow}$ ASM-CODE

2002 – 2004: ASM-CODE

Import data:

1974 – 1988:TSUSA $\overset{(a)}{\rightarrow}$ SIC 72 $\overset{(b)}{\rightarrow}$ SIC 87 $\overset{(d)}{\rightarrow}$ NAICS $\overset{(e)}{\rightarrow}$ ASM-CODE

1989 – 2004: HTS $\rightarrow\rightarrow \overset{(c)}{\rightarrow} \rightarrow\rightarrow$ SIC 87 $\overset{(d)}{\rightarrow}$ NAICS $\overset{(e)}{\rightarrow}$ ASM-CODE

However, there is a problem. An industry in a classification code does not always match that in another classification code on a one to one basis. For example, industry classification number 2048 in SIC 87 corresponds to both 311119 and 311611 in NAICS.

In order to solve this problem, I aggregate such cases and create my own classification code, “ASM-HK”, which has consistency for convertibility among all six classification codes listed above. Thus I can have an original concordance between SIC72/SIC87/NAICS/ASM codes and ASM-HK. For example, I create 311GHI by aggregating two industries (311119 + 311611) to correspond to 2048 in

SIC 87 so that we have a one-to-one relation between two different classification codes. ASM-HK has just 100 industrial classification codes. Appendix II provides the details about its construction. Appendix III shows the manufacturing industries corresponding to each ASM-HK code. Appendix IV shows the concordance between ASM-HK code and all industrial classification codes of SIC 72, SIC 87, NAICS, and ASM.

C. Panel data

My data is organized in the form of panel data. Import data and industrial data are organized and made in the following manner;

C – 1. Import data

All raw data is yearly data. First, I replace classification code in all data into one with ASM-HK. For data during 1974-1988,

(i) TSUSA is converted into SIC 72 in line with the concordance between TSUSA and SIC 72.

(ii) Delete all non-manufacturing industries codes (such as 3-digit codes, 1000s and 9000s codes) so that data with SIC 72 starts with 2000s (2011) and ends with 3999 (SIC of 2011-3999 corresponds to manufacturing industries).

(iii) Replace SIC 72 with corresponding ASM-HK using my own concordance between SIC 72 and ASM-HK (Appendix IV).

For data during1989-2004,

(i) HTS is converted into SIC 87 in line with the concordance between HTS and SIC 87.

(ii) Delete all non-manufacturing industries codes (such as 3-digit codes, 1000s and 9000s codes) so that data with SIC 87 starts with 2000s (2011) and ends with 3999 (SIC of 2011-3999 corresponds to manufacturing industries).

(iii) Replace SIC 87 with corresponding ASM-HK using my own concordance for SIC 87 and ASM-HK (Appendix IV).

Then, we make the panel data of import data for each country.

C – 2. Industry data (1974-2004)

All raw data is yearly data. First, I replace each classification code with ASM-HK and then, I make panel data for manufacturing industry data.

D. Missing observations

There are missing observations among both the industry data and the import data. For the industry data, most of them occur in capital expenditures during 1978-1999 (all data during this period is collected based on SIC code). I have tried to make up values of missing observations using 2-digit, 3-digit SIC code, and my own ASM-HK code. I have faced 3 cases to fix this problem in general, each of which is shown in Appendix V. As shown in Appendix V, I could not always make up missing values, in which case, I have left those blank. I have calculated the possible effect of these missing values on the research to be conducted as follows and found out that this level of influence was not critical;

(i) Total missing values is estimated to be $5,469.46 million.

(ii) Total capital expenditure including missing values is estimated to be $3,041,968.79 million.

(iii) Missing values account for about 0.18% of total amount.

Missing values in import data are indicated by a blank field.

VII. Specifications

A. First-stage regression

For the modeling of our specification of the first-stage regression, I assume $\Delta \log p_{jt}$ (percentage change in U.S. domestic product prices for industry j at time t) depends on trade barriers, U.S. import variables and U.S. industrial variables. I use U.S. tariffs and transportation costs for trade barriers, exchange rate between U.S. currency and foreign currencies for import variable, and TFP, U.S. output share and capital-labor ratio for industrial variables. I measure all causal variables in changes following Haskel and Slaughter (2003), that is, changes in trade barriers (tariffs and transportation costs) are measured as level changes and changes in all other variables are measured as percentage changes. I will explain why trade barriers such as tariffs and transportation costs are measured as level changes. Suppose tariff rates declines to zero %. Tariff reductions have sector biases in level terms since the larger tariff cuts, for example, will be in the unskilled intensive sectors. But tariff reductions have no sector biases in terms of percentage changes since all sectors experience a 100% tariff reduction. Therefore, I focus on level changes of tariffs and transportation costs. Table 2 summarizes statistics (mean and standard deviation) for all variables. Then, the estimating equation for explaining $\Delta \log p_{jt}$ (first-stage regression) is given by:

$$\Delta \log p_{jt} = \alpha_1 \Delta Tariff_{jt}^{c} + \alpha_2 \Delta Tariff_{jt}^{row} + \alpha_3 \Delta Trans_{jt}^{c} + \alpha_4 \Delta Trans_{jt}^{row}$$

$$+\alpha_5 \Delta \log TFP_{jt} + \alpha_6 \Delta \log Outputshare_{jt} + \alpha_7 \Delta \log KLratio_{jt}$$

$$+\alpha_8 \Delta \log Exrate_t^{Twei} + \lambda D_j + \varepsilon_{jt} \qquad (12)$$

Here, j is the industry. There are 100 industries. t is the year, from 1974 to 2004. Superscript "c" shows a country, "Canada", "Mexico", "Israel", "Chile", "Jordan", "Singapore" (for individual effect), "CanadaMexico" (for the first combined effect using weighted average of U.S. tariffs on imports from both Canada and Mexico), "AllFTA" (for the second combined effect using weighted average of U.S. tariffs on imports from six FTA countries), and "World" (for the third combined effect using weighted average of U.S. tariffs on imports from all countries in the world).

"$\Delta \log p_{jt}$" is the percentage change in product prices for industry j at time t. I use value added price[12] in each industry following Haskel and Slaughter (2003).

"$\Delta Tariff_{jt}^{c}$" is the change in U.S. tariff rate on imports from country "c" for industry j at time t. "$Tariff_{jt}^{c}$" is calculated as total duties collected as a share of total customs value of imports for consumption[13]. "$\Delta Tariff_{jt}^{row}$" is the change in U.S. tariff rate on import from rest of the world (all countries except country "c") for industry j at time t. "$\Delta Trans_{jt}^{c}$" and "$\Delta Trans_{jt}^{row}$" are the change in transportation cost for

[12] ASM (2004) explains value added price as follows;
"This measure of manufacturing activity is derived by subtracting the cost of materials, supplies, containers, fuel, purchased electricity, and contract work from the value of shipments (products manufactured plus receipts for services rendered). The result of this calculation is adjusted by the addition of value added by merchandising operations (i.e., the difference between the sales value and the cost of merchandise sold without further manufacture, processing, or assembly) plus the net change in finished goods and work-in-process between the beginning-and end-of-year inventories."

[13] Custom value for 1989-2004 has two types, imports for consumption and general imports, while custom value for 1974-1988 has only one type, imports for consumption. Therefore, I have used "custom value, imports for consumption" for this analysis from the consistency point of view.

import of commodity j at time t from country "c" and that from rest of the world (all countries except "c"). "$Trans_{jt}^{c}$" and "$Trans_{jt}^{row}$" are calculated as import charges[14] as a share of total customs value of imports for consumption. "$\Delta \log TFP$" is the percentage change in total factor productivity for industry j at time t. "$\Delta \log Outputshare_{jt}$" is the percentage change in share of U.S. output for industry j in total manufacturing industry at time t. "$Outputshare_{jt}$" is calculated by a share of total manufacturing industry output. Total manufacturing industry output are given by amount of total value of shipments in manufacturing industries. "$\Delta \log KLratio_{jt}$" is the percentage change in capital-labor ratio for industry j. "$\Delta \log Exrate_{t}^{twei}$" is the percentage change in exchange rate for trade weighted exchange index with major currencies. This is a weighted average of the foreign exchange value of the U.S. dollar against major currencies. Major currencies include Euro area, Canada, Japan, United Kingdom, Switzerland, Australia, and Sweden. The data is obtainable in monthly trade weighted exchange index with major currencies in Economic Data-Fred ® provided by Federal Reserve Bank of St. Louis. "D_j" is industry dummies. A constant term is not included in the specification in order to avoid dummy variable trap. Estimated $\tilde{\alpha}_1$ shows how much change in U.S. tariffs on imports from "c" affects the percentage change in domestic product prices. I expect

[14] Import charge is not listed in Feenstra (1996) during 1974-1988. Therefore, I have constructed it by calculating [(CIF value) – (custom value)]. Please note that there are some observations reporting CIF value smaller than the custom value, in which case, I set transportation costs equal to zero. Also, CIF value is not reported in Feenstra et al (2002) for the period of 1989-2004, in which case, I have constructed CIF value as [(custom value, imports for consumption) + (import charge)].

$\tilde{\alpha}_1$ to be positive, that is, an increase in a tariff rate should lead to an increase in the corresponding domestic product price.

B. Second-stage regression

For the second-stage regression, I use three factors of production, unskilled workers, skilled workers and rental price of capital. Following Haskel and Slaughter (2003), I use production workers from ASM for unskilled workers and all other employees from ASM (total workers minus production workers) for skilled workers. For the rental price of capital, I sum up new capital expenditure and used capital expenditure to calculate total capital expenditure.

There are many arguments about the classification for skilled workers and unskilled workers (Leamer 1994). According to Explanation of Terms of appendix A in the ASM 2004, "The production workers number includes workers (up through the line-supervisor level) engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, shipping (but not delivering), maintenance, repair, janitorial and guard services, product development, auxiliary production for plant's own use (e.g., power plant), recordkeeping, and other services closely associated with these production operations at the establishment covered by the report. Employees above the working-supervisor level are excluded from this item". Meanwhile, all other employees (total workers minus production workers) are defined as "The other employees covers non-production employees of the manufacturing establishment including those engaged in factory supervision above the line-supervisor level. It includes sales (including driver-salespersons), sales delivery (highway truck drivers and their helpers), advertising, credit, collection, installation and servicing of own products, clerical and routine office functions, executive, purchasing, financing, legal, personnel (including cafeteria, medical, etc), professional, and technical employees. Also included are employees on the payroll of the manufacturing establishment engaged in the construction of major additions or alterations utilized as a separate work force".

As shown above, if I regard all other employees as skilled workers and production workers as unskilled workers, skilled workers include sales delivery, clerical and routine office function, cafeteria personnel, and construction, while unskilled workers include line-supervisor and product development. Therefore, this classification does not work perfectly to distinguish unskilled workers and skilled workers. However, in the absence of a better classification, I will follow the general practice of the literature and use this one.

The regressand of second-stage regression, "$\tilde{\alpha}_1 \Delta Tariff_{jt}^{c}$" is computed in the first-stage regression. I, then, in the second regression, $\tilde{\alpha}_1 \Delta Tariff_{jt}^{c}$ is regressed on the factor shares for skilled workers (θ_{sjt}), unskilled workers (θ_{ujt}), and rental price of capital (θ_{rjt}). That is, the specification of second-stage regression is:

$$\tilde{\alpha}_1 \Delta Tariff_{jt}^{c} = \beta_s \theta_{sjt} + \beta_u \theta_{ujt} + \beta_r \theta_{rjt} + \gamma D_j + e_{jt} \qquad (13)$$

"θ_{sjt}" is cost share for skilled workers in industry j at time t, "θ_{ujt}" is cost share for unskilled workers in industry j at time t, and "θ_{rjt}" is cost share for capital in industry j at time t. These are constructed as factor's share of total value of shipments[15], following Haskel and Slaughter (2003). Estimated coefficients $\tilde{\beta}_s$ and $\tilde{\beta}_u$ are percentage changes in wages for skilled workers and unskilled workers mandated by change in tariffs, working through change of product prices. Taking the difference between $\tilde{\beta}_s$ and $\tilde{\beta}_u$ gives us an estimate of how the reduction of the tariff changes the wage gap.

VIII. Results

Table 3 through Table 11 report the results of the regression I conducted for the individual effects and the combined effects of reductions of U.S. tariffs on imports from FTA countries on the wage gap between skilled workers and unskilled workers, working through product price changes.

A. The effect of U.S. tariffs on imports from Canada on the wage gap

A – 1. Entire 1974 – 2004 period

The results of this estimation are reported in the left hand column of Table 3. The first-stage regression (equation (12)), shows the estimated correlation between product price changes and changes in U.S. tariffs on imports from Canada. It says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about + 0.02%. Product price changes are positively correlated with the change in

[15] ASM (2004) explains total value shipment as follows;
"Total value of shipment includes the received or receivable net selling values, "Free on Board (FOB) plant (exclusive of freight and taxes), of all products shipped, both primary and secondary, as well as all miscellaneous receipts, such as receipts for contract work performed for others, installation and repair, sales of scrap, and sales of products bought and sold without further processing. Included are all items made by or for the establishments from material owned by it, whether sold, transferred to other plants of the same company, or shipped on consignment. The net selling value of products made in one plant on a contract basis from materials owned by another was reported by the plant providing the materials."

U.S. tariffs on Canadian imports. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{Canada}$ and $\Delta Trans_{jt}^{row}$) have statistically insignificant effects on the changes in product prices, while the import variable, $\Delta \log Exrate_{t}^{twei}$ and domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) show statistically significant effects on the change in product prices at the 1% level.

To estimate wage changes mandated by U.S. tariff reduction induced product price changes, I estimate the second-stage regressions (equation (13)). It says that the reduction of U.S. tariffs on imports from Canada during 1974-2004, working through product price changes, mandated a fall in the wage for skilled workers ($\tilde{\beta}_s$) by 0.06% and mandated a rise in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.01%, resulting in a mandated fall in the wage gap ($\tilde{\beta}_s < \tilde{\beta}_u$) by 0.07%. However, these results are not statistically significantly different from zero.

A – 2. Pre FTA period (1974 – 1987)

The results for this period are reported in the middle column of Table 3. The first-stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about - 0.02%. Product price changes are negatively correlated with the change in U.S. tariffs on Canadian imports. However, this correlation is not statistically significantly different from zero. A trade variable, $\Delta Trans_{jt}^{row}$ shows statistically significant effect on product price changes at the 10%

level while all other trade barrier variables ($\Delta Tariff_{jt}^{row}$ and $\Delta Trans_{jt}^{Canada}$) have statistically insignificant effects on the changes in product prices. The import variables, $\Delta \log Exrate_t^{twei}$ and domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) show statistically significant effects on change in product prices at the 1% level.

The second-stage regressions says that the reduction of U.S. tariffs on imports from Canada during 1974-1987 (pre FTA period), working through product price changes, mandated a rise in the wage for skilled workers ($\tilde{\beta}_s$) by 0.19% and mandated a fall in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.07%, resulting in a mandated rise in the wage gap ($\tilde{\beta}_s > \tilde{\beta}_u$) by 0.26%. However, these results are not statistically significantly different from zero.

A – 3. Post FTA period (1988 – 2004)

The results for this period are reported in the right hand column of Table 3. The first-stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about + 0.01%. Product price changes are positively correlated with the change in U.S. tariffs on Canadian imports. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{Canada}$ and $\Delta Trans_{jt}^{row}$) and the import variable, $\Delta \log Exrate_t^{Twei}$ have statistically insignificant effects on the changes in product prices, while the domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and

$\Delta \log KLratio_{jt}$) show statistically significant effects on change in product prices at the 1% level.

The second-stage regression says that the reduction of U.S. tariffs on imports from Canada during 1988-2004 (post FTA period) mandated a rise in the wage for skilled workers ($\tilde{\beta}_s$) by 0.01% and mandated a fall in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.04%, resulting in a mandated rise in the wage gap ($\tilde{\beta}_s > \tilde{\beta}_u$) by 0.04%. However, these results are not statistically significantly different from zero.

A – 4. Summary of the effect of U.S. tariffs on imports from Canada on the wage gap

First, U.S. tariffs on imports from Canada mandated a fall in U.S. wage gap through product price changes in U.S. manufacturing industry during 1974-2004. However the size of this mandated fall is very small, far less than 1%, and is not statistically significantly different from zero. Second, U.S. tariffs on imports from Canada mandated a rise in the wage gap during the pre FTA period (1974-1987) and the post FTA period (1988-2004). But these effects are very small, less than 1%, and are not statistically significantly different from zero. Therefore, U.S. tariffs on imports from Canada do not have any significant effects on the wage gap between skilled workers and unskilled workers during the periods considered.

B. The effect of U.S. tariffs on imports from Mexico on the wage gap

B – 1. Entire 1974 – 2004 period

The results of this estimation are reported in the left hand column of Table 4. The first-stage regression says that if the tariff rate changes by 1%, the percentage

change in product price ($\hat{p}$) is about - 0.06%. Product price changes are negatively correlated with the change in U.S. tariffs on Mexican imports. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{Mexico}$ and $\Delta Trans_{jt}^{row}$), import variable, $\Delta \log Exrate_{t}^{twei}$ and domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) have statistically insignificant effects on the changes in product prices.

The second-stage regression says that the reduction of U.S. tariffs on imports from Mexico during 1974-2004, working through product price changes, mandated a fall in the wage for skilled workers ($\tilde{\beta}_s$) by 0.13% and mandated a rise in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.16%, resulting in a mandated fall in the wage gap ($\tilde{\beta}_s < \tilde{\beta}_u$) by 0.29%. However, these results are not statistically significantly different from zero.

B – 2. Pre FTA period

The results for this period are reported in the middle column of Table 4. The first-stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about - 0.05%. Product price changes are negatively correlated with the change in U.S. tariffs on Mexican imports. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{Mexico}$ and $\Delta Trans_{jt}^{row}$) have statistically insignificant effects on the changes in product prices, while the import variable, $\Delta\log Exrate_t^{twei}$ and domestic industrial variables ($\Delta\log TFP_{jt}$, $\Delta\log Outputshare_{jt}$ and $\Delta\log KLratio_{jt}$) show statistically significant effects on change in product prices at the 1% level.

The second-stage regressions says that the reduction of U.S. tariffs on imports from Mexico during 1974-1993 (pre FTA period), working through product price changes, mandated a rise in the wage for skilled workers ($\tilde{\beta}_s$) by 0.01% and mandated a fall in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.04%, resulting in a mandated rise in the wage gap ($\tilde{\beta}_s > \tilde{\beta}_u$) by 0.05%. However, these results are not statistically significantly different from zero.

B – 3. Post FTA period (1994 – 2004)

The results for this period are reported in the right hand column of Table 4. The first stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about - 0.02%. Product price changes are negatively correlated with the change in U.S. tariffs on Mexican imports. However, this correlation is not statistically significantly different from zero. The trade variable $\Delta Tariff_{jt}^{row}$ shows statistically significant effect on product price changes at the 10% level. All other trade barrier variables ($\Delta Trans_{jt}^{Mexico}$ and $\Delta Trans_{jt}^{row}$) and the import variable, $\Delta\log Exrate_t^{Twei}$ have statistically insignificant effects on the changes in product prices, while the domestic industrial variables ($\Delta\log TFP_{jt}$,

$\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) show statistically significant effects on change in product prices at the 1% level.

The second-stage regression says that the reduction of U.S. tariffs on imports from Mexico during 1994-2004 (post FTA period) mandated a fall in the wage for skilled workers ($\tilde{\beta}_s$) by 0.09% and mandated a rise in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.07%, resulting in a mandated fall in the wage gap ($\tilde{\beta}_s < \tilde{\beta}_u$) by 0.16%. However, these results are not statistically significantly different from zero.

B – 4. Summary of the effect of U.S. tariffs on imports from Mexico on the wage gap

First, U.S. tariffs on imports from Mexico mandated a fall in U.S. wage gap through product price changes in U.S. manufacturing industry during 1974-2004. However the size of this mandated fall is very small, far less than 1%, and is not statistically significantly different from zero. Second, U.S. tariffs on imports from Mexico mandated a rise in the wage gap before the U.S.-Mexico FTA started, while it mandated a fall after the U.S.-Mexico FTA started. But these effects are very small, less than 1%, and are not statistically significantly different from zero. Therefore, U.S. tariffs on imports from Mexico do not have any significant effects on the wage gap between skilled workers and unskilled workers during the periods considered.

C. The effect of U.S. tariffs on imports from Israel on the wage gap

C – 1. Entire 1974 – 2004 period

The results of this estimation are reported in the left hand column of Table 5. The first-stage regression says that if the tariff rate changes by 1%, the percentage

change in product price ($\hat{p}$) is about - 0.04%. Product price changes are negatively correlated with the change in U.S. tariffs on imports from Israel. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{Israel}$ and $\Delta Trans_{jt}^{row}$) show statistically insignificant effects on product price changes, while the import variable, $\Delta \log Exrate_{t}^{twei}$ and domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) have statistically significant effects on the changes in product prices at the 1% level.

The second-stage regression says that the reduction of U.S. tariffs on imports from Israel during 1974-2004, working through product price changes, mandated a fall in the wage for skilled workers ($\tilde{\beta}_s$) by 0.10% and mandated a rise in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.26%, resulting in a mandated fall in the wage gap ($\tilde{\beta}_s < \tilde{\beta}_u$) by 0.35%. However, these results are not statistically significantly different from zero.

C – 2. Pre FTA period (1974 – 1984)

The results for this period are reported in the middle column of Table 5. The first-stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about - 0.03%. Product price changes are negatively correlated with the change in U.S. tariffs on imports from Israel. However, this correlation is not statistically significantly different from zero. For other trade variables, $\Delta Trans_{jt}^{row}$ shows statistically significant effect on product price changes at the 10% level, while $\Delta Tariff_{jt}^{row}$ and $\Delta Trans_{jt}^{Israel}$ have statistically insignificant effects on product price changes. The import variable, $\Delta \log Exrate_{t}^{twei}$ and domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) show statistically significant effects on the changes in product prices at the 1% level.

The second-stage regressions says that the reduction of U.S. tariffs on imports from Israel during 1974-1984 (pre FTA period), working through product price changes, mandated a fall in the wage for skilled workers ($\tilde{\beta}_s$) by 0.37% and mandated a rise in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.02%, resulting in a mandated fall in the wage gap ($\tilde{\beta}_s < \tilde{\beta}_u$) by 0.39%. However, these results are not statistically significantly different from zero.

C – 3. Post FTA period (1985 – 2004)

The results for this period are reported in the right hand column of Table 5. The first-stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about - 0.08%. Product price changes are negatively correlated with the change in U.S. tariffs on imports from Israel. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{Israel}$ and $\Delta Trans_{jt}^{row}$) have statistically insignificant effects on the changes in product prices. Meanwhile the import variable, $\Delta \log Exrate_{t}^{Twei}$ and domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$

and $\Delta \log KLratio_{jt}$) show statistically significant effects on the changes in product prices at the conventional level.

The second-stage regression says that the reduction of U.S. tariffs on imports from Israel during 1985-2004 (post FTA period) mandated a fall in the wage for skilled workers ($\tilde{\beta}_s$) by 0.15% and mandated a rise in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.62%, resulting in a mandated fall in the wage gap ($\tilde{\beta}_s < \tilde{\beta}_u$) by 0.76%. However, these results are not statistically significantly different from zero.

C – 4. Summary of the effect of U.S. tariffs on imports from Israel on the wage gap

First, U.S. tariffs on imports from Israel mandated a fall in U.S. wage gap through product price changes in U.S. manufacturing industry during 1974-2004. However the size of this mandated fall is very small, far less than 1%, and is not statistically significantly different from zero. Second, U.S. tariffs on imports from Israel mandated a fall in the wage gap before the U.S.-Israel FTA started and it also mandated a fall after the U.S.-Israel FTA started. But these effects are small and are not statistically significantly different from zero. Therefore, U.S. tariffs on imports from Israel do not have any significant effects on the wage gap between skilled workers and unskilled workers during the periods considered.

D. The effect of U.S. tariffs on imports from Jordan on the wage gap

D – 1. Entire 1974 – 2004 period

The results of this estimation are reported in the left hand column of Table 6. The first-stage regression says that if the tariff rate changes by 1%, the percentage

change in product price ($\hat{p}$) is about - 0.01%. Product price changes are negatively correlated with the change in U.S. tariffs on imports from Jordan. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{Jordan}$ and $\Delta Trans_{jt}^{row}$) show statistically insignificant effects on product price changes, while all domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) and the import variable, $\Delta \log Exrate_{t}^{twei}$ have statistically significant effects on the changes in product prices at the 1% level.

The second-stage regression says that the reduction of U.S. tariffs on imports from Jordan during 1974-2004, working through product price changes, mandated a fall in the wage for skilled workers ($\tilde{\beta}_s$) by 0.003% and mandated a fall in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.02%, resulting in a mandated rise in the wage gap ($\tilde{\beta}_s > \tilde{\beta}_u$) by 0.02%. However, these results are not statistically significantly different from zero.

D – 2. Pre FTA period (1974 – 2000)

The results for this period are reported in the middle column of Table 6. The first-stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about - 0.01%. Product price changes are negatively correlated with the change in U.S. tariffs on imports from Jordan. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{Jordan}$ and $\Delta Trans_{jt}^{row}$) show statistically insignificant effects on product price changes, while all domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) and the import variable, $\Delta \log Exrate_t^{twei}$ have statistically significant effects on the changes in product prices at the 1% level.

The second-stage regressions says that the reduction of U.S. tariffs on imports from Jordan during 1974-2000 (pre FTA period), working through product price changes, mandated a fall in the wage for skilled workers ($\tilde{\beta}_s$) by 0.01% and mandated a fall in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.02%, resulting in a mandated rise in the wage gap ($\tilde{\beta}_s > \tilde{\beta}_u$) by 0.01%. However, these results are not statistically significantly different from zero.

D – 3. Post FTA period (2001 – 2004)

The results for this period are reported in the right hand column of Table 6. The first stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about - 0.21%. Product price changes are negatively correlated with the change in U.S. tariffs on imports from Jordan. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{Jordan}$ and $\Delta Trans_{jt}^{row}$) and the import variable, $\Delta \log Exrate_t^{twei}$ show statistically insignificant effects on product price changes, while all domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) have statistically significant effects on the changes in product prices at the 1% level.

The second-stage regression says that the reduction of U.S. tariffs on imports from Jordan during 2000-2004 (post FTA period), working through product price changes, mandated a fall in the wage for skilled workers ($\tilde{\beta}_s$) by 2.51% and mandated a rise in the wage for unskilled workers ($\tilde{\beta}_u$) by 2.26%, resulting in a mandated fall in the wage gap ($\tilde{\beta}_s < \tilde{\beta}_u$) by 4.77%. However, these results are not statistically significantly different from zero.

D – 4. Summary of the effect of U.S. tariffs on imports from Jordan on the wage gap

First, U.S. tariffs on imports from Jordan mandated a rise in U.S. wage gap through product price changes in U.S. manufacturing industry during 1974-2004. However the size of this mandated rise is very small, far less than 1%, and is not statistically significantly different from zero. Second, U.S. tariffs on imports from Jordan mandated a rise in the wage gap before the U.S.-Jordan FTA started, while it mandated a fall after the U.S.-Jordan FTA started. But these effects are not statistically significantly different from zero. Therefore, U.S. tariffs on imports from Jordan do not have any significant effects on the wage gap between skilled workers and unskilled workers during the periods considered.

E. The effect of U.S. tariffs on imports from Chile on the wage gap

Since the U.S.-Chile FTA started in 2003, I analyze the effect during the entire periods of 1974-2004 only, and do not analyze the effect during the pre FTA period and the post FTA period.

The results are reported in Table 7. The first-stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about -0.0004%. Product price changes are negatively correlated with the change in U.S. tariffs on imports from Chile. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{Chile}$ and $\Delta Trans_{jt}^{row}$) show statistically insignificant effects on product price changes, while all domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) and the import variables, $\Delta \log Exrate_{t}^{twei}$ have statistically significant effects on the changes in product prices at the 1% level.

The second-stage regression says that the reduction of U.S. tariffs on imports from Chile during 1974-2004, working through product price changes, mandated a rise in the wage for skilled workers ($\tilde{\beta}_s$) by 0.0002% and mandated a fall in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.0005%, resulting in a mandated rise in the wage gap ($\tilde{\beta}_s > \tilde{\beta}_u$) by 0.0007%. However, these results are not statistically significantly different from zero.

Therefore, U.S. tariffs on imports from Chile do not have any significant effects on the wage gap between skilled workers and unskilled workers during 1974-2004.

F. The effect of U.S. tariffs on imports from Singapore on the wage gap

Since the U.S.-Singapore FTA started in 2004, I analyze the effect during the entire periods of 1974-2004 only, and do not consider analyzing the effect during the pre FTA period and the post FTA period.

The results are reported in Table 8. The first-stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about -0.06%. Product price changes are negatively correlated with the change in U.S. tariffs on imports from Singapore. This correlation is statistically significantly different from zero at the 5% level. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{Singapore}$ and $\Delta Trans_{jt}^{row}$) show statistically insignificant effects on product price changes, while the import variable, $\Delta \log Exrate_{t}^{twei}$ and all domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) have statistically significant effects on the changes in product prices at the 1% level.

The second-stage regression says that the reduction of U.S. tariffs on imports from Singapore during 1974-2004 mandated a fall in the wage for skilled workers ($\tilde{\beta}_s$) by 0.21% and mandated a fall in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.04%, resulting in a mandated fall in the wage gap ($\tilde{\beta}_s < \tilde{\beta}_u$) by 0.17%. However, these results are not statistically significantly different from zero.

Therefore, U.S. tariffs on imports from Singapore do not have any significant effects on the wage gap between skilled workers and unskilled workers during 1974-2004.

G. The combined effect of U.S. tariffs on imports from both Canada and Mexico on the wage gap

I analyze the effect during the entire periods of 1974-2004 only because of the combined effect.

The results are reported in Table 9. The first-stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about -0.08%. Product price changes are negatively correlated with the change in weighted average of U.S. tariffs on both Canadian imports and Mexican imports. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{CanadaMexico}$ and $\Delta Trans_{jt}^{row}$) show statistically insignificant effects on product price changes, while the import variable $\Delta \log Exrate_{t}^{twei}$ and domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) have statistically significant effects on the changes in product prices at the 1% level.

The second-stage regression says that the reduction of weighted average of U.S. tariffs on imports from both Canada and Mexico during 1974-2004, working through product price changes, mandated a rise in the wage for skilled workers ($\tilde{\beta}_s$) by 0.29% and mandated a fall in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.19%, resulting in a mandated rise in the wage gap ($\tilde{\beta}_s > \tilde{\beta}_u$) by 0.48%. However, these results are not statistically significantly different from zero.

Therefore, U.S. tariffs on imports from both Canada and Mexico do not have any significant effects on the wage gap between skilled workers and unskilled workers during 1974-2004.

H. The combined effect of U.S. tariffs on imports from all 6 FTA countries on the wage gap

I analyze the effect during the entire periods of 1974-2004 only because of the combined effect.

The results are reported in Table 10. The first-stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about -0.05%. Product price changes are negatively correlated with the change in weighted average of U.S. tariffs on imports from 6 FTA countries. However, this correlation is not statistically significantly different from zero. All other trade barrier variables ($\Delta Tariff_{jt}^{row}$, $\Delta Trans_{jt}^{AllFTA}$ and $\Delta Trans_{jt}^{row}$) show statistically insignificant effects on product price changes, while the import variable $\Delta \log Exrate_t^{twei}$ and domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) have statistically significant effects on the changes in product prices at the 1% level.

The second-stage regression says that the reduction of weighted average of U.S. tariffs on imports from 6 FTA countries during 1974-2004, working through product price changes, mandated a rise in the wage for skilled workers ($\tilde{\beta}_s$) by 0.11% and mandated a rise in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.04%, resulting in a mandated rise in the wage gap ($\tilde{\beta}_s > \tilde{\beta}_u$) by 0.06%. However, these results are not statistically significantly different from zero.

Therefore, U.S. tariffs on imports from all 6 FTA countries do not have any significant effects on the wage gap between skilled workers and unskilled workers during 1974-2004.

I. The combined effect of U.S. tariffs on imports from all countries in the world on the wage gap

I analyze the effect during 1974-2004 only because of the combined effect.

The results are reported in Table 11. The first-stage regression says that if the tariff rate changes by 1%, the percentage change in product price ($\hat{p}$) is about + 0.01%. Product price changes are positively correlated with the change in weighted average of U.S. tariffs on imports from all countries in the world. However, this correlation is not statistically significantly different from zero. Other trade barrier variable, $\Delta Trans_{jt}^{World}$ shows statistically insignificant effect on product price changes, while the import variable, $\Delta \log Exrate_{t}^{twei}$ and domestic industrial variables ($\Delta \log TFP_{jt}$, $\Delta \log Outputshare_{jt}$ and $\Delta \log KLratio_{jt}$) have statistically significant effects on the changes in product prices at the 1% level.

The second-stage regression says that the reduction of weighted average of U.S. tariffs on imports from all countries in the world during 1974-2004, working through product price changes, mandated a fall in the wage for skilled workers ($\tilde{\beta}_s$) by 0.02% and mandated a rise in the wage for unskilled workers ($\tilde{\beta}_u$) by 0.02%, resulting in a mandated fall in the wage gap ($\tilde{\beta}_s < \tilde{\beta}_u$) by 0.04%. However, these results are not statistically significantly different from zero.

Therefore, U.S. tariffs on imports from all countries in the world do not have any significant effects on the wage gap between skilled workers and unskilled workers during 1974-2004. This result of insignificant effect of U.S. tariffs on the wage gap is consistent with Haskel and Slaughter (2003).

IX. Summary

A. Summary of the results

I have examined whether the reduction of U.S. tariffs, working through product price changes, raised the wage gap between skilled workers and unskilled workers in U.S. manufacturing industries during 1974-2004. I also divided the entire periods of 1974-2004 into two periods, the pre FTA period and the post FTA period, in each case, to estimate the effect of U.S. tariff reduction on the wage gap. I used U.S. tariffs on imports from countries which have FTAs with the U.S. These countries are Canada, Mexico, Israel, Jordan, Chile and Singapore.

The results are summarized as follows. I will look at the individual effect first. I estimated that U.S. tariff reductions on imports from Canada, Mexico, Israel and Singapore, working through product price changes, mandated a fall in the wage gap in U.S. manufacturing industries during 1974-2004. On the other hand, U.S. tariff reductions on imports from Jordan and Chile mandated a rise in the wage gap during the same period. However, in all cases, the size of the effect of U.S. tariff reductions on imports from each country on the wage gap is quite small, less than 1%, and these effects are not statistically significantly different from zero. Next, I summarize the combined effect. Our estimates indicate that the combined effect of U.S. tariff reductions on imports from Canada and Mexico, working through product price changes, was to raise the wage gap in U.S. manufacturing industries during 1974-

2004. I obtained the same result for the combined effect of U.S. tariffs on goods from all 6 FTA countries. However, all of these effects are not statistically significantly different from zero. Third, same results of insignificant effects on the wage gap were obtained when I estimated each individual effect during the pre FTA period and during the post FTA period. All of these results indicate that U.S. tariff reductions on imports from FTA countries did not have any statistically significant effects on mandated changes in the wage gap in U.S. manufacturing industries during the periods considered. Finally, when I estimated the effect of U.S. tariffs on imports from all countries in the world, I did not obtain any significant findings that U.S. tariff reductions raised the wage gap in the U.S. This result is consistent with Haskel and Slaughter (2003).

We found in the first-stage regression that reduction of U.S. tariffs does not have any statistically significant effects on product price changes in most of all cases, in other words, most of first-stage regressions show very weak correlation between the change in product prices and the change in U.S. tariffs. Following Hanson and Harrison (1999), this suggests that aggregated prices may be poor measures of actual product price changes, that is, all data aggregated into 100 industries for concordance in this analysis may be a poor measure of actual changes in tariff rate and product prices. It appears that the weak correlation between change in tariff rate and change in product prices in the first-stage regression may have resulted in the insignificant effects of tariff induced product price changes on the wage inequality between skilled workers and unskilled workers in the second-stage regression.

B. Robustness checks

I estimated the consequences of various model specifications to test the robustness of the results in Table 3 through Table 10 in a number of ways. First, I assumed a lagged effect (three years difference) between tariff changes and wages. Second, I incorporated variable returns to scale into the model since Helpman and Krugman (1985) argue about scale effect that the gains from increasing returns to scale could accrue to all factors and thus permit the scarce factor to gain from trade. Third, I changed causal variables in the first-stage regression (12).

All checks found that the results did not change, that is, all of checks show insignificant mandated change in the wage gap in U.S. manufacturing industries.

B – 1. Test of lagged effect between tariff changes and wages

I have set up three years difference between tariff and wage data (θ_{sjt}, θ_{ujt}, and θ_{rjt}). For example, tariff data and product price data in 1974 corresponds to wage data in 1977.

The specification of the model in the first stage regression is:

$$\begin{aligned} \Delta \log p_{jt} = {} & \alpha_1 \Delta 3yearlagTariff_{jt}^{c} + \alpha_2 \Delta 3yearlagTariff_{jt}^{row} + \alpha_3 \Delta Trans_{jt}^{c} + \alpha_4 \Delta Trans_{jt}^{row} \\ & + \alpha_5 \Delta \log TFP_{jt} + \alpha_6 \Delta \log Outputshare_{jt} + \alpha_7 \Delta \log KLratio_{jt} \\ & + \alpha_8 \Delta \log Exrate_{t}^{Twei} + \lambda D_j + \varepsilon_{jt} \qquad (14) \end{aligned}$$

Superscript “c” shows all cases already listed in the previous sections. “$\Delta 3yearlagTariff_{jt}^{c}$” is change in U.S. tariff rate on import from country “c” for industry j having three years time lag with wage data.

Specification in the second-stage regression is:

$$\tilde{\alpha}_1 \Delta 3yearlagTariff_{jt}^{c} = \beta_s \theta_{sjt} + \beta_u \theta_{ujt} + \beta_r \theta_{rjt} + \gamma D_j + e_{jt} \qquad (15)$$

The results are shown in Table 12 through Table 14. All checks for both individual effect and combined effect with lagged effect of three-year difference of U.S. tariff reductions on the wage gap are not statistically significantly different from zero.

B – 2. Test of incorporation of variable returns to scale

Let X_j represent output of industry j. Assume that economies of scale are external to individual firms and internal to industry, following Jones (1968), so that I could still use zero profit condition.

To measure variable returns to scale, we define $R_{ij} = \frac{\partial a_{ij}}{\partial X_j}\frac{X_j}{a_{ij}}$, that is, R_{ij} shows percentage change in a_{ij} corresponding to a 1% change in the output of industry j at a constant factor prices.

I derive the model based on the equation (2) and following Jones (1968) to get;

$$\hat{p}_j = \sum_{i=1}^{I} \theta_{ij} \hat{w}_i + R_j \hat{X}_j \qquad j = 1, ..., J \qquad (16)^{16}$$

where, R_j shows θ weighted average of R_{ij} 's in each industry yielding the degree of returns to scale, that is, $R_j = \theta_{1j} R_{1j} + \theta_{2j} R_{2j} + ... + \theta_{(I-1)j} R_{(I-1)j} + \theta_{Ij} R_{Ij}$.

Then, the first-stage regression is same as equation (10):

[16] See Appendix VI for the derivation of the equation (16)

$$\hat{p}_j = Z_j\alpha + D_j\lambda + \varepsilon_j \qquad j = 1,........., J$$

$$\text{or} \qquad \hat{p} = Z\alpha + D\lambda + \varepsilon \qquad (10)$$

The second-stage regression is:

$$Z_j\tilde{\alpha} = \sum_{i=1}^{I}\theta_{ij}\delta_i + R_j\hat{X}_j + D_j\gamma_j + e_j \qquad j = 1,........., J$$

$$\text{where } R_j = \theta_{1j}R_{1j} + \theta_{2j}R_{2j} + ... + \theta_{(I-1)j}R_{(I-1)j} + \theta_{Ij}R_{Ij},$$

$$R_{ij} = \frac{\partial a_{ij}}{\partial X_j}\frac{X_j}{a_{ij}}$$

$$\text{or} \qquad Z\tilde{\alpha} = \theta\delta + R\hat{X} + D\gamma + e \qquad (17)$$

where, $Z\tilde{\alpha}$ is the contribution to $\hat{p}$ of each causal variable obtained from the first-stage regression with (J xT) x 1 vector, θ is factor cost shares with (J xT) x I matrix, δ is a parameter to be estimated with I x 1 vector, R is (J x T) x (J xT) matrix, $\hat{X}$ is (J x T) x 1 vector, and e is an error term with (J xT) x 1 vector. D is industry dummies with (J xT) x K diagonal matrix and γ is an estimated coefficient of D with K x 1 vector. We can see how the estimated coefficients $\hat{\delta}$, the percentage change in factor prices mandated by each causal variable working through $\hat{p}$, is affected by the scale effect ($R_j\hat{X}_j$) in comparison with the results shown in Table 3 through Table 10.

The results are summarized in Table 15 and Table 16. All checks for the incorporation of variable returns to scale into the model show statistically insignificant mandated change in U.S. wage gap.

B – 3. Change in causal variables in the first-stage regression

I have changed causal variables in equation (12) in two ways.

(a) Exclusion of $\Delta Tariff_{jt}^{row}$ and $\Delta Trans_{jt}^{row}$ variables

Trade barrier variables, $\Delta Tariff_{jt}^{c}$ and $\Delta Tariff_{jt}^{row}$, and $\Delta Trans_{jt}^{c}$ and $\Delta Trans_{jt}^{row}$ are highly correlated in many cases as shown in Table 17. Therefore, I exclude "rest of the world" variables ($\Delta Tariff_{jt}^{row}$ and $\Delta Trans_{jt}^{row}$) to test the robustness of the results obtained from Table 3 through Table 10.

The first specification is:

$$\Delta \log p_{jt} = \alpha_1 \Delta Tariff_{jt}^{c} + \alpha_3 \Delta Trans_{jt}^{c} + \lambda D_j + \varepsilon_{jt} \qquad (18)$$

The second specification has only trade variables. That is:

$$\Delta \log p_{jt} = \alpha_1 \Delta Tariff_{jt}^{c} + \alpha_2 \Delta Tariff_{jt}^{row} + \alpha_3 \Delta Trans_{jt}^{c} + \alpha_4 \Delta Trans_{jt}^{row} + \lambda D_j + \varepsilon_{jt} \qquad (19)$$

The third specification deletes exchange rate variable from the equation (12), that is:

$$\begin{aligned} \Delta \log p_{jt} = {} & \alpha_1 \Delta Tariff_{jt}^{c} + \alpha_3 \Delta Trans_{jt}^{c} + \alpha_5 \Delta \log TFP_{jt} \\ & + \alpha_6 \Delta \log Outputshare_{jt} + \alpha_7 \Delta \log KLratio_{jt} + \alpha_8 \Delta \log Exrate_{t}^{Twei} \\ & + \lambda D_j + \varepsilon_{jt} \qquad (20) \end{aligned}$$

The specifications of second-stage regression corresponding to first-stage regression (18) through (20) are same as equation (13), that is,

$$\tilde{\alpha}_1 \Delta Tariff_{jt}^{c} = \beta_s \theta_{sjt} + \beta_u \theta_{ujt} + \beta_r \theta_{rjt} + \gamma D_j + e_{jt} \qquad (13)$$

The results are shown in Table 18 through Table 25. All checks for the exclusion of $\Delta Tariff_{jt}^{row}$ and $\Delta Trans_{jt}^{row}$ variables show statistically insignificant mandated changes in the wage gap between skilled workers and unskilled workers.

(b) Inclusion of variable, $\Delta \log Impprice_{jt}^{c}$

It is not clear if "$\Delta \log Impprice_{jt}^{c}$" can be an explanatory variable in the first-stage regression. So I did not include this variable as a main analysis in this dissertation. "$\Delta \log Impprice_{jt}^{c}$" is percentage change in import price from country c for industry j at time t. I use customs value of imports for consumption for "$impprice^{c}$".

The specification is based on equation (12), that is,

$$\begin{aligned}\Delta \log p_{jt} &= \alpha_1 \Delta Tariff_{jt}^{c} + \alpha_2 \Delta Tariff_{jt}^{row} + \alpha_3 \Delta Trans_{jt}^{c} + \alpha_4 \Delta Trans_{jt}^{row} \\ &+ \alpha_5 \Delta \log TFP_{jt} + \alpha_6 \Delta \log Outputshare_{jt} + \alpha_7 \Delta \log KLratio_{jt} \\ &+ \alpha_8 \Delta \log Exrate_{t}^{Twei} + \alpha_9 \Delta \log Impprice_{jt}^{c} + \lambda D_j + \varepsilon_{jt} \qquad (21)\end{aligned}$$

The second stage equation is same as equation (13), that is,

$$\tilde{\alpha}_1 \Delta Tariff_{jt}^{c} = \beta_s \theta_{sjt} + \beta_u \theta_{ujt} + \beta_r \theta_{rjt} + \gamma D_j + e_{jt} \qquad (13)$$

The results are summarized in Table 26 through Table 32. A variable $\Delta \log Impprice_{jt}^{c}$ shows statistically significant effect on product price changes in most of cases. But all checks for the inclusion of import price variable show statistically insignificant mandated change in U.S. wage gap between skilled workers and unskilled workers.

X. Conclusion

This dissertation, based on the essential idea of Stolper and Samuelson (1941) and following the mandated wage methodology with the two-stage procedure of Haskel and Slaughter (2003), examines whether the reduction of U.S. tariffs, working through product price changes, raised the wage gap between skilled workers and unskilled workers in U.S. manufacturing industries during 1974-2004. I estimated the individual effect of U.S. tariff reductions on imports from countries which have the free trade agreements with the U.S during 1974-2004. These countries are Canada, Mexico, Israel, Jordan, Chile and Singapore. I estimated two combined effects of (i) U.S. tariff reductions on imports from both Canada and Mexico, and (ii) those on imports from 6 FTA countries, on wages for both types of workers during the same period (1974-2004). Second, I divided the entire periods of 1974-2004 into two periods, the pre FTA period and the post FTA period. I then estimated the individual effects during the pre FTA period and the post FTA period in order to see how the effect of U.S. tariff reductions on the wage gap changes between the two periods. Furthermore, I estimated the effect of U.S. tariffs on imports from all countries in the world during 1974-2004 for the purpose of comparison with Haskel and Slaughter (2003).

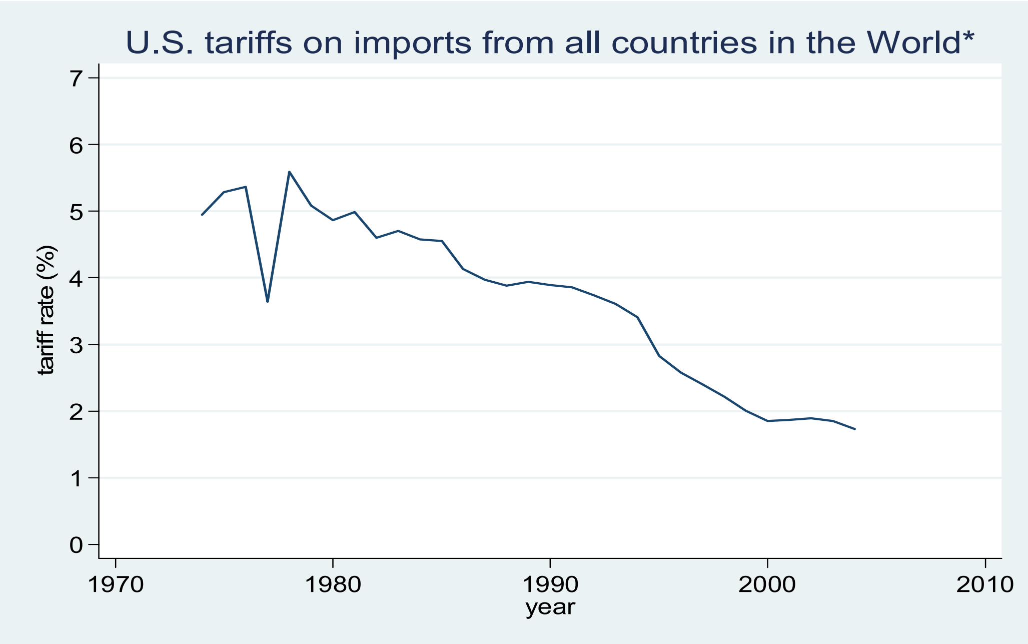
Main findings are as follows. First, U.S. tariff reductions on imports from Canada, Mexico, Israel and Singapore mandated a fall in the wage gap in U.S. manufacturing industries during 1974-2004. On the other hand, the result was reversed when I estimated the effect of U.S. tariff reductions on imports from Jordan and Chile during the same period. However, in all cases, the effects are not statistically significantly from different from zero. Second, the combined effect of U.S. tariff reductions on imports from Canada and Mexico raised the wage gap in U.S. manufacturing industries during 1974-2004. I obtained the same result for the combined effect of U.S. tariff on goods from all 6 FTA countries. However, all of these effects are not statistically significantly different from zero. Third, the same insignificant results were obtained when I estimated each individual effect during the pre FTA period and during the post FTA period. All of these results show that U.S. tariff reductions on imports from FTA countries did not have any statistically significant effects on mandated changes in the wage gap in U.S. manufacturing industries during the periods considered. Finally, when I estimated the effect of U.S. tariffs on imports from all countries in the world, my result was consistent with that of Haskel and Slaughter (2003), who did not obtain any significant evidence that U.S. tariff reduction raised the wage gap in the U.S. Thus, this dissertation does not find any significant evidence that U.S. tariff reductions expanded the wage inequality between skilled workers and unskilled workers in U.S. manufacturing industries during 1974-2004. These results lead us to conclude that other forces must explain the increasing U.S. wage inequality. It appears that the weak correlation between tariff induced product prices and wage gap in all cases might be caused by the weak correlation between change in tariff and product price changes in the first-stage regression. This might have been caused by the aggregation of all data into 100 industries for concordance, which may be a poor measure of change in U.S. tariff rates and product prices as Hanson and Harrison (1999) pointed out. The above conclusion did not change when I estimated the consequences of various model specifications such as three years lagged effect between tariffs and wages, incorporation of variable returns to scale into the model and change of causal variables.

My findings are consistent with those of Harigan (2000), Haskel and Slaughter (2003) and Trefler (2004), who found no significant evidence that tariff reductions widened the wage inequality, while my results are not consistent with other past studies such as Gaston and Trefler (1992), Leamer (1993), Brown et al (1993), Borjas and Ramey (1994), Feenstra and Hanson (1997), Borjas, Freeman and Katz (1997), Leamer (1998), Revenga and Montenegro (1998), Feenstra and Hanson (1999), Hanson and Harrison (1999), Baldwin and Cain (2000), and Robertson (2004). A couple of reasons for this difference could be considered. First, different variables are used to measure trade liberalization: Leamer (1998) and Baldwin and Cain (2000), assuming trade liberalization affected product prices, used product price changes, Leamer (1993), Borjas and Ramey (1994) used U.S. import volume, Feenstra and Hanson (1997) used foreign direct investment, Borjas, Freeman and Katz (1997) used number of immigrants, Feenstra and Hanson (1999) used foreign outsourcing, and Gaston and Trefler (1992) and Brown et al (1993) used tariff reductions. I used tariff induced product price changes, which shows what share of price variation is due to tariff changes. A second reason is the regression method employed. Other studies which found that trade liberalization has an impact on the wage gap employed a conventional regression to estimate, for example, the direct relation between product price and wage gap. I used a two-stage procedure to estimate the relationship between tariff rates induced product price changes and the wage gap. Third, the following studies estimated the effects of trade liberalization in Mexico on Mexican wages, not the effect of U.S. tariff reductions on U.S. wages: Revenga and Montenegro (1998), Hanson and Harrison (1999) and Robertson (2004).

The results of this dissertation have given me some ideas for future work. First, similar tariff reductions on imports from U.S. have been implemented in FTA countries, which I considered in this dissertation. It will be worth conducting the same analysis for the relationship between reduction of tariffs and wage inequality in these FTA countries using the same method. Second, U.S. has been reducing tariff rates on imports from many countries and regions. It would be interesting to investigate the effect of those tariff reductions on wage inequality in the U.S. Third, I have concluded that rising wage inequality is the result of something other than tariff reductions. The first-stage regressions indicated that an import variable such as exchange rate and some industrial variables such as TFP, U.S. output share, and capital-labor ratio have significant effects on changes in product prices. I can investigate the effect of these variables on wage inequality. Fourth, I have not considered non-tariff barriers in this analysis. It will be worth conducting the analysis of the effect of non-tariff barriers on wages. Fifth, it will be interesting to look at other channel than tariff-product price channel such as tariff-technological channel. Tariff reduction may cause technological change, which may decrease the relative demand for low-skill workers in the U.S. and thus their relative wages. Sixth, I can look at the effects of U.S. tariff on Canadian wages and Mexican wages as well. For example, U.S.-Mexico trade is small in volume in terms of U.S. GDP but it is not small from Mexican point of view. Thus, the U.S. tariff reductions may affect Mexican wages.

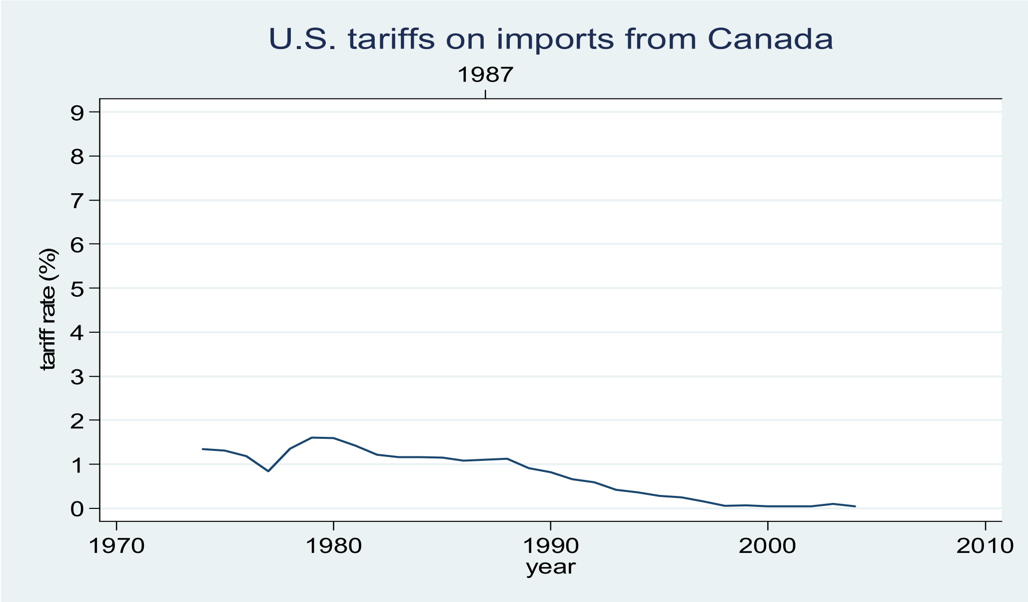
Figures (1 – 9) and Tables (1 – 32)

<Figure 1>



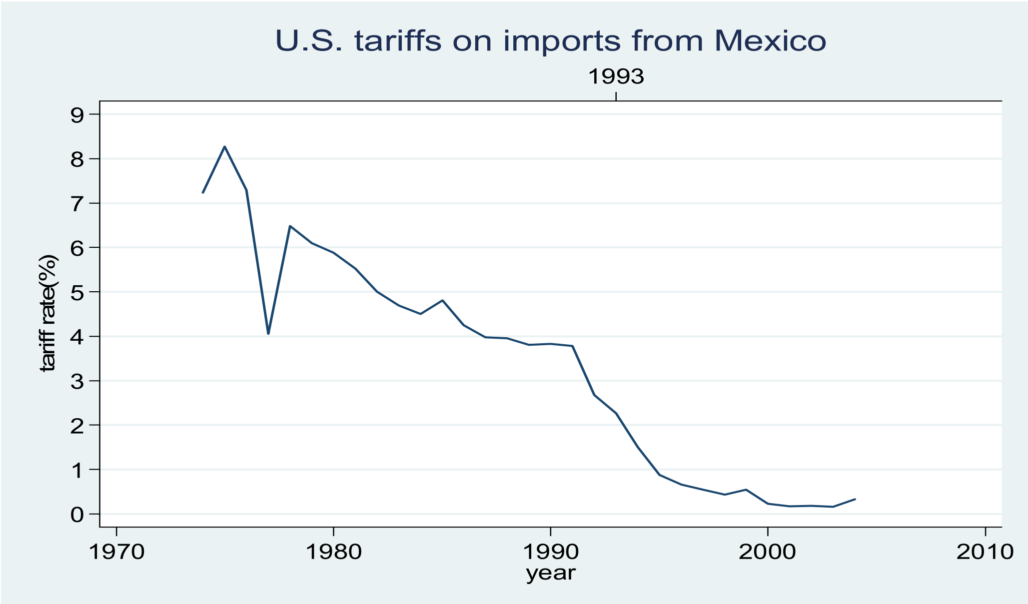
* shows the weighted average of U.S. tariffs on imports from all countries in the world. Sources: Feenstra (1996) for 1974-1988, Feenstra et al (2002) for 1989-2001 and U.S. Bureau of the Census for 2002-2004. See text for details of construction of tariff rate. All calculations are by the author.

<Figure 2>



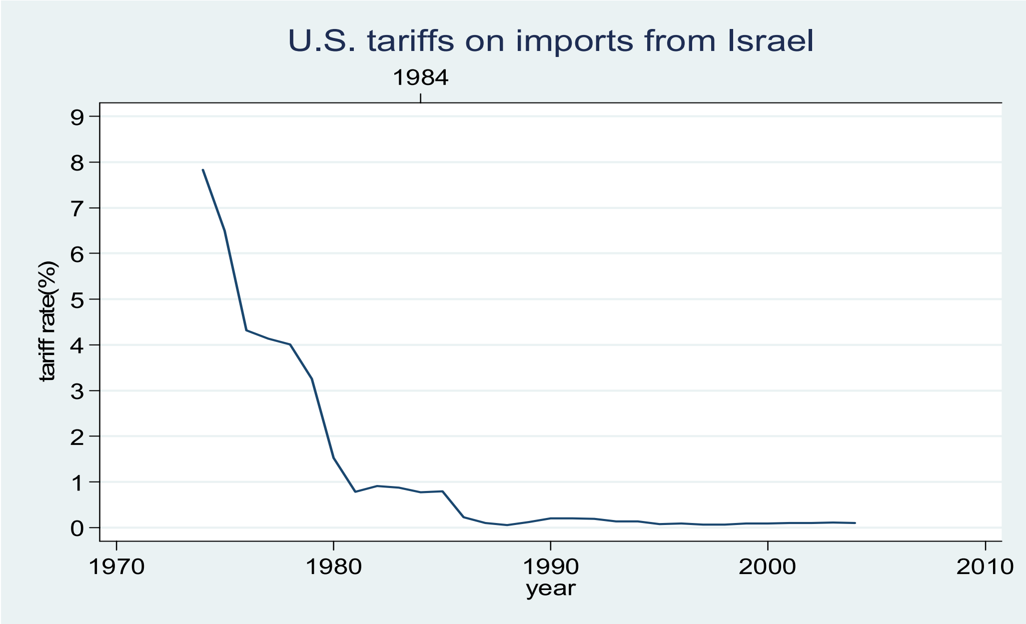
Sources: Feenstra (1996) for 1974-1988, Feenstra et al (2002) for 1989-2001 and U.S. Bureau of the Census for 2002-2004. See text for details of construction of tariff rate. All calculations are by the author.

<Figure 3>



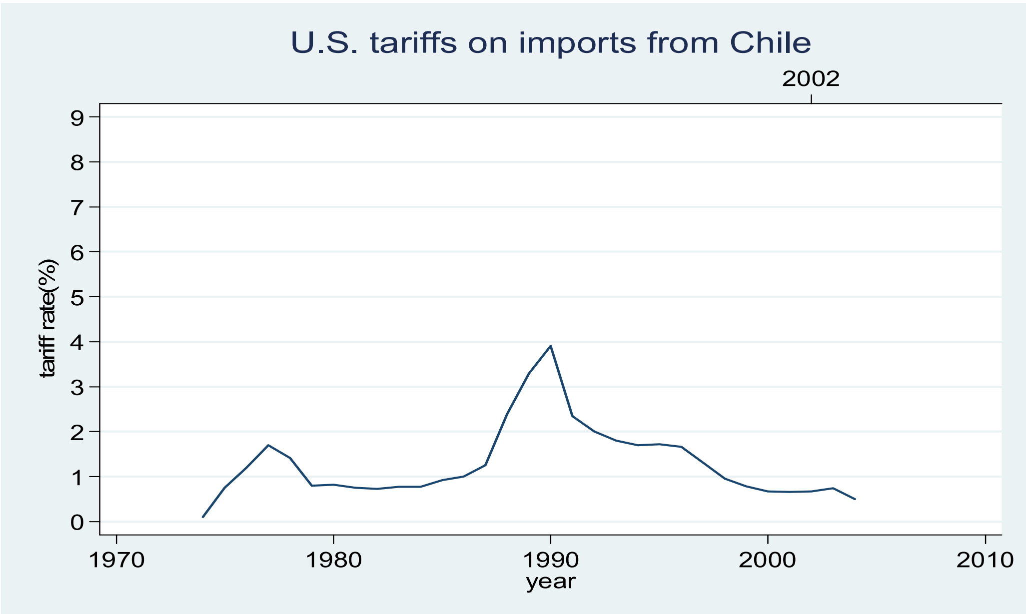
Sources: Feenstra (1996) for 1974-1988, Feenstra et al (2002) for 1989-2001 and U.S. Bureau of the Census for 2002-2004. See text for details of construction of tariff rate. All calculations are by the author.

<Figure 4>



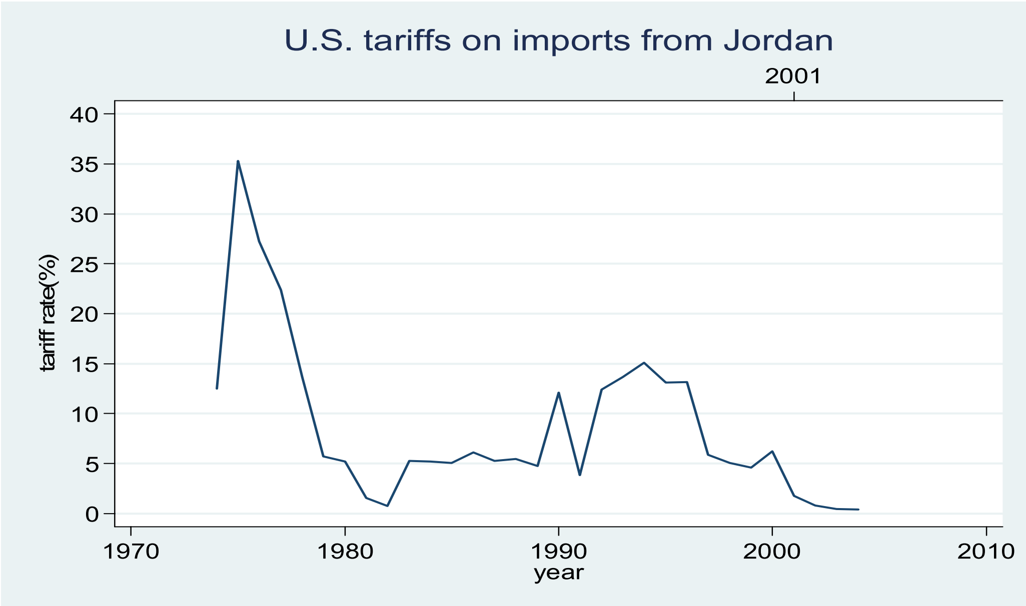
Sources: Feenstra (1996) for 1974-1988, Feenstra et al (2002) for 1989-2001 and U.S. Bureau of the Census for 2002-2004. See text for details of construction of tariff rate. All calculations are by the author.

<Figure 5>



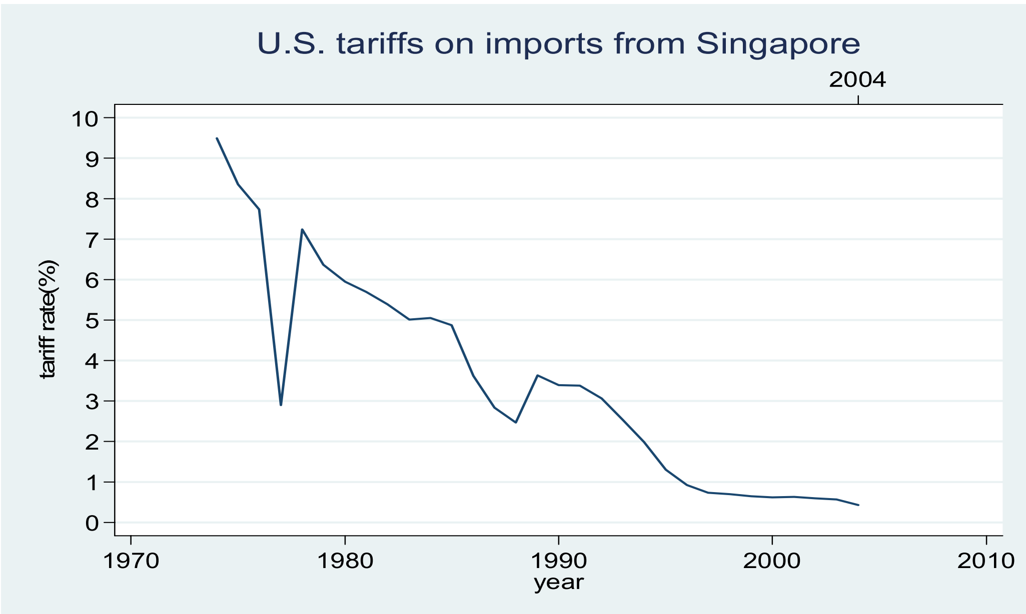
Sources: Feenstra (1996) for 1974-1988, Feenstra et al (2002) for 1989-2001 and U.S. Bureau of the Census for 2002-2004. See text for details of construction of tariff rate. All calculations are by the author.

<Figure 6>



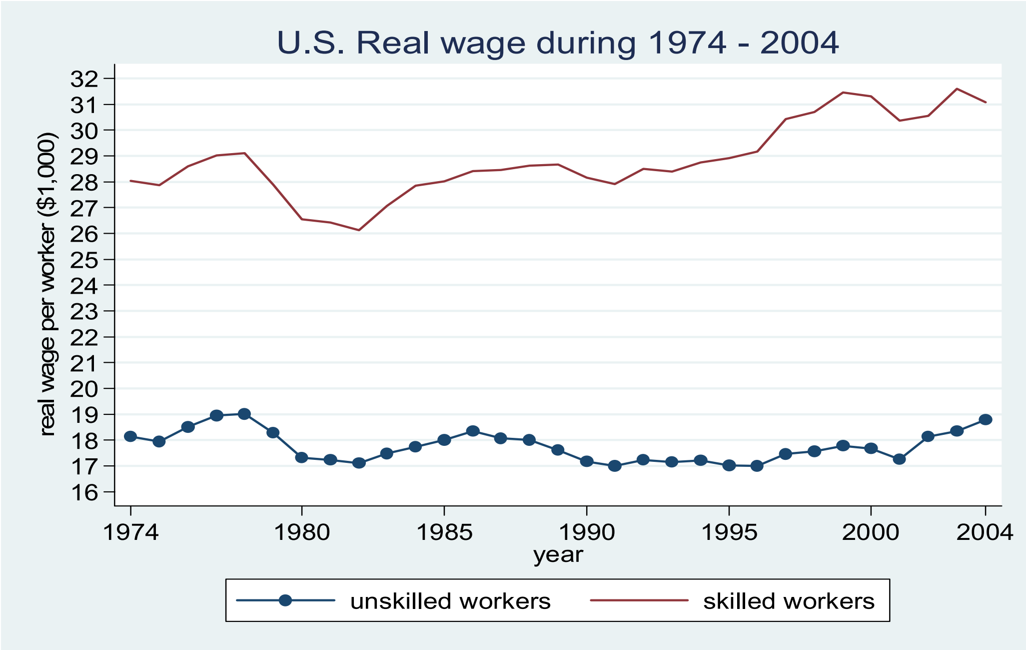
Sources: Feenstra (1996) for 1974-1988, Feenstra et al (2002) for 1989-2001 and U.S. Bureau of the Census for 2002-2004. See text for details of construction of tariff rate. All calculations are by the author.

<Figure 7>



Sources: Feenstra (1996) for 1974-1988, Feenstra et al (2002) for 1989-2001 and U.S. Bureau of the Census for 2002-2004. See text for details of construction of tariff rate. All calculations are by the author.

<Figure 8>



Sources: Annual Survey of Manufactures for 1974-2004. See the text for construction of variables. All calculations are by the author.

<Figure 9>

Sources: Annual Survey of Manufactures for 1974-2004. See the text for construction of variables. All calculations are by the author.

<Table - 1> **Change of U.S. Tariff**

U.S. - Canada[1]	%change	average annual change
Pre FTA (1974-1987)	-18.07	-1.52
Post FTA (1988-2004)	-95.66	-17.81
1974-2004	-96.37	-10.46

U.S. - Mexico[2]	%change	average annual change
Pre FTA (1974-1993)	-68.70	-5.93
Post FTA (1994-2004)	-78.20	-14.13
1974-2004	-95.46	-9.79

U.S. - Israel[3]	%change	average annual change
Pre FTA (1974-1984)	-90.14	-20.68
Post FTA (1985-2004)	-87.59	-10.40
1974-2004	-98.73	-13.55

U.S. - Jordan[4]	%change	average annual change
Pre FTA (1974-2001)	-85.96	-7.01
Post FTA (2002-2004)	-51.51	-30.37
1974-2004	-96.96	-10.99

U.S. - Chile[5]	%change	average annual change
1974-2004	362.16	5.23

U.S. - Singapore[5]	%change	average annual change
1974-2004	-95.45	-9.79

U.S. - World[6]	%change	average annual change
1974-2004	-64.97	-3.21

(1) U.S. - Canada FTA was in effect in 1988.

(2) U.S. - Mexico FTA was in effect in 1994.

(3) U.S. - Israel FTA was in effect in 1985.

(4) U.S. - Jordan FTA was in effect in 2001.

(5) U.S. - Chile FTA was in effect in 2003
and U.S. - Singapore FTA was in 2004.
We see the entire periods (1974 - 2004) only for these two cases.

(6) Weighted average of US tariff on imports from all countries in the world

<Table 2>

Summary Statistics

	Mean	(Standard Deviation)
Change in product prices (Δlog p)	-0.0020407	(0.065)
Factor share for skilled workers	0.0696144	(0.041)
Factor share for unskilled workers	0.1233947	(0.058)
Factor share for capital	0.038639	(0.027)
Change in output share (Δoutshare)	0.0174329	(3.182)
Change in TFP (Δlog TFP)	-0.0004665	(0.053)
Change in K/L ratio (ΔKLratio)	-0.0818553	(13.699)
Change in exchange rate (Δlog $ExRate^{TWEI}$)	-0.0025007	(0.029)
Change in U.S. tariff rates on Imports from Canada ($\Delta Tariff^{Canada}$)	-0.1419206	(1.550)
Change in transportation costs on imports from Canada ($\Delta Trans^{Canada}$)	-0.0147807	(1.782)
Change in U.S. tariff rates on imports from Mexico ($\Delta Tariff^{Mexico}$)	-0.1199324	(1.822)
Change in transportation costs on imports from Mexico ($\Delta Trans^{Mexico}$)	0.0449486	(3.174)
Change in weighted average of U.S. tariff rates on imports from Canada & Mexico ($\Delta Tariff^{CanadaMexico}$)	-0.1503855	(1.569)
Change in weighted average of transportation costs on imports from Canada & Mexico ($\Delta Trans^{CanadaMexico}$)	-0.0072456	(1.581)
Change in U.S. tariff rates on imports from Chile ($\Delta Tariff^{Chile}$)	-0.002133	(2.335)
Change in transportation costs on imports from Chile ($\Delta Trans^{Chile}$)	0.1539525	(12.927)
Change in U.S. tariff rates on imports from Israel ($\Delta Tariff^{Israel}$)	-0.1124524	(2.529)

	Mean	(Standard Deviation)
Change in transportation costs on imports from Israel ($\Delta Trans^{Israel}$)	-0.0788522	(12.028)
Change in U.S. tariff rates on imports from Jordan ($\Delta Tariff^{Jordan}$)	-0.0000959	(2.677)
Change in transportation costs on imports from Jordan ($\Delta Trans^{Jordan}$)	0.1107435	(8.999)
Change in U.S. tariff rates on imports from Singapore ($\Delta Tariff^{Singapore}$)	-0.0392297	(2.856)
Change in transportation costs on imports from Singapore ($\Delta Trans^{Singapore}$)	0.0660328	(14.849)
Change in U.S. tariff rates on imports from All 6 FTA countries ($\Delta Tariff^{AllFTA}$)	-0.1608913	(3.569)
Change in transportation costs on imports from All 6 FTA countries ($\Delta Trans^{AllFTA}$)	-0.0203291	(1.498)
Change in U.S. tariff rates on imports from all countries ($\Delta Tariff^{World}$)	-0.1255852	(2.071)
Change in transportation costs on imports from all countries ($\Delta Trans^{World}$)	-0.0239492	(3.782)

<Table 3> **Regression results: U.S. Tariffs on imports from Canada**

1st - Stage: Eq. (12)	(Dependent Variable: P* = Δlog P)		
	1974 - 2004	**Pre FTA period**	**Post FTA period**
$\Delta Tariff^{Canada}$	0.000163	-0.0002048	0.0000723
	(0.29)	(0.30)	(0.06)
$\Delta Trans^{Canada}$	0.0002104	0.0009569	-0.0011972
	(0.41)	(1.40)	(1.47)
$\Delta Tariff^{Row}$	-0.0002055	0.0001039	-0.0004233
	(0.54)	(0.14)	(1.02)
$\Delta Trans^{Row}$	0.0000353	0.0005091*	0.0000425
	(0.18)	(1.63)	(0.17)
ΔlogTFP	-0.3014418***	-0.7309133***	-0.1962062***
	(8.36)	(8.74)	(5.05)
ΔlogOutputshare	1.625703***	2.12306***	1.532142***
	(30.09)	(18.92)	(23.22)
ΔlogKLratio	0.0224163***	0.0542581***	0.0289867***
	(4.20)	(5.47)	(4.22)
$\Delta logExRate^{Twei}$	-0.1596394***	-0.1924639***	-0.0505572
	(5.18)	(4.61)	(1.08)
R-sq.	0.5229	0.5895	0.4936
Obs.	2630	1123	1526

2nd - Stage: Eq. (13)	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
	1974 - 2004	**Pre FTA period**	**Post FTA period**
ϴs (β_s)	-0.0005736	0.0018804	0.0000759
	(0.08)	(0.06)	(0.00)
ϴu (β_u)	0.0001143	-0.000673	-0.000357
	(0.02)	(0.05)	(0.02)
ϴr	0.0003016	-0.0012839	-0.0000559
	(0.02)	(0.04)	(0.00)
R-sq.	0.0252	0.0245	0.0888
Obs.	2630	1123	1526
Wage gap			
$\beta_s - \beta_u$	-0.0006879	0.0025534	0.0004329
	(0.06)	(0.07)	(0.01)
	narrow	expand	expand

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 4> **Regression results: U.S. Tariffs on imports from Mexico**

1st - Stage: Eq. (12) (Dependent Variable: P* = Δlog P)

	1974 - 2004	**Pre FTA period**	**Post FTA period**
$\Delta Tariff^{Mexico}$	-0.0005759	-0.0004758	-0.0002151
	(0.77)	(0.86)	(0.11)
$\Delta Trans^{Mexico}$	-0.0000687	0.0003783	0.0001988
	(0.16)	(1.16)	(0.30)
$\Delta Tariff^{Row}$	0.0004048	0.0001976	-0.004477*
	(0.61)	(0.42)	(1.76)
$\Delta Trans^{Row}$	0.0005888	0.0007797	-0.001927
	(0.75)	(1.32)	(1.31)
ΔlogTFP	0.1146393	-0.7077185***	-0.9304922***
	(1.46)	(10.68)	(10.05)
ΔlogOutputshare	-0.1558091	2.128039***	2.566426***
	(1.43)	(23.58)	(18.89)
ΔlogKLratio	-0.0079928	0.0290376***	0.1036811***
	(0.94)	(4.31)	(8.49)
$\Delta logExRate^{Twei}$	-0.0474316	-0.1824857***	-0.0364398
	(1.04)	(4.82)	(0.70)
R-sq.	0.0327	0.5817	0.5426
Obs.	2416	1547	954

2nd - Stage: Eq. (13) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	1974 - 2004	**Pre FTA period**	**Post FTA period**
ϴs (β_s)	-0.0013406	0.0001277	-0.0008532
	(0.27)	(0.01)	(0.02)
ϴu (β_u)	0.0015643	-0.0003524	0.0007208
	(0.43)	(0.04)	(0.02)
ϴr	-0.0004869	-0.0005499	0.0000459
	(0.15)	(0.02)	(0.00)
R-sq.	0.0388	0.0660	0.1038
Obs.	2416	1547	954
Wage gap			
$\beta_s - \beta_u$	-0.0029049	0.0004801	-0.001574
	(0.39)	(0.02)	(0.03)
	narrow	expand	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 5> **Regression results: U.S. Tariffs on imports from Israel**

1st - Stage: Eq. (12)	(Dependent Variable: P* = Δlog P)		
	1974 - 2004	**Pre FTA period**	**Post FTA period**
$\Delta Tariff^{Israel}$	-0.0004211	-0.0002717	-0.0008015
	(1.25)	(0.66)	(1.03)
$\Delta Trans^{Israel}$	-0.0000793	-0.0001037	-0.00000908
	(1.13)	(1.13)	(0.08)
$\Delta Tariff^{Row}$	-0.0002097	-0.0005842	-0.0003554
	(0.44)	(0.64)	(0.65)
$\Delta Trans^{Row}$	-0.0000383	0.0014459*	-0.0001288
	(0.17)	(1.76)	(0.56)
ΔlogTFP	-0.3005086***	-0.7324393***	-0.2341664***
	(8.35)	(7.54)	(6.07)
ΔlogOutputshare	1.625098***	2.172345***	1.589331***
	(30.10)	(16.76)	(25.26)
ΔlogKLratio	0.0222577***	0.0491224***	0.0181225***
	(4.17)	(4.19)	(2.94)
$\Delta logExRate^{Twei}$	-0.1606734***	-0.4268982***	-0.0827053**
	(5.23)	(5.73)	(2.36)
R-sq.	0.5247	0.5746	0.5179
Obs.	2634	900	1753

2nd - Stage: Eq. (13)	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
	1974 - 2004	**Pre FTA period**	**Post FTA period**
ϴs (β_s)	-0.0009688	-0.0036878	-0.0014607
	(0.13)	(0.06)	(0.12)
ϴu (β_u)	0.002569	0.0001905	0.0061599
	(0.46)	(0.00)	(0.54)
ϴr	-0.001059	-0.0019556	-0.0019812
	(0.05)	(0.05)	(0.07)
R-sq.	0.0157	0.0187	0.0744
Obs.	2634	900	1753
Wage gap			
$\beta_s - \beta_u$	-0.0035378	-0.0038783	-0.0076206
	(0.32)	(0.04)	(0.57)
	narrow	narrow	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 6> **Regression results: U.S. Tariffs on imports from Jordan**

1st - Stage: Eq. (12) (Dependent Variable: P* = Δlog P)

	1974 - 2004	**Pre FTA period**	**Post FTA period**
$\Delta Tariff^{Jordan}$	-0.0001342	-0.0001457	-0.0020692
	(0.42)	(0.45)	(1.25)
$\Delta Trans^{Jordan}$	0.0000288	0.0000501	-0.0000443
	(0.30)	(0.51)	(0.13)
$\Delta Tariff^{Row}$	-0.000297	-0.0002529	0.0097429
	(0.63)	(0.54)	(1.30)
$\Delta Trans^{Row}$	-0.00000816	0.0000282	-0.002623
	(0.03)	(0.12)	(0.99)
ΔlogTFP	-0.3015455***	-0.296611***	-1.210353***
	(8.38)	(8.09)	(6.70)
ΔlogOutputshare	1.626407***	1.619052***	2.959039***
	(30.15)	(29.46)	(11.39)
ΔlogKLratio	0.0222606***	0.015624***	0.1074669***
	(4.17)	(2.85)	(6.38)
$\Delta logExRate^{Twei}$	-0.1591535***	-0.1947319***	0.0878218
	(5.17)	(5.83)	(1.12)
R-sq.	0.5241	0.5442	0.7638
Obs.	2634	2375	272

2nd - Stage: Eq. (13) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	1974 - 2004	**Pre FTA period**	**Post FTA period**
ϴs (β_s)	-0.0000371	-0.0000845	-0.0251436
	(0.01)	(0.01)	(0.16)
ϴu (β_u)	-0.0002368	-0.0001727	0.0225805
	(0.05)	(0.05)	(0.17)
ϴr	0.0000656	0.0000975	0.008428
	(0.00)	(0.00)	(0.06)
R-sq.	0.0010	0.0016	0.1559
Obs.	2634	2375	272
Wage gap			
$\beta_s - \beta_u$	0.0001997	0.0000882	-0.0477241
	(0.02)	(0.01)	(0.34)
	expand	expand	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 7> **Regression results: U.S. Tariffs on imports from Chile**

1st - Stage: Eq. (12) (Dependent Variable: P* = Δlog P)

	1974 - 2004[(1)]	Pre FTA period[(1)]	Post FTA period[(1)]
$\Delta Tariff^{Chile}$	-0.00000387		
	(0.01)		
$\Delta Trans^{Chile}$	-0.0000705		
	(1.08)		
$\Delta Tariff^{Row}$	-0.0002849		
	(0.60)		
$\Delta Trans^{Row}$	-0.00000807		
	(0.03)		
ΔlogTFP	-0.3025125***		
	(8.38)		
ΔlogOutputshare	1.628264***		
	(30.09)		
ΔlogKLratio	0.0221743***		
	(4.13)		
$\Delta logExRate^{Twei}$	-0.159454***		
	(5.17)		
R-sq.	0.5243		
Obs.	2611		

2nd - Stage: Eq. (13) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	1974 - 2004[(1)]	Pre FTA period[(1)]	Post FTA period[(1)]
Θs (β_s)	0.00000168		
	(0.00)		
Θu (β_u)	-0.00000528		
	(0.00)		
Θr	0.0000161		
	(0.00)		
R-sq.	0.0035		
Obs.	2611		
Wage gap			
$\beta_s - \beta_u$	0.00000696		
	(0.00)		
	expand		

(xxxx) shows absolute t-statistics. * shows significance at 10% level.

** shows significance at 5% level. *** shows significance at 1% level.

(1) As U.S. - Chile FTA started in 2002, analysis for only 1974-2004 was conducted.

<Table 8> **Regression results: U.S. Tariffs on imports from Singapore**

1st - Stage: Eq. (12)	(Dependent Variable: P* = Δlog P)		
	1974 - 2004(1)	**Pre FTA period(1)**	**Post FTA period(1)**
$\Delta Tariff^{Singapore}$	-0.000593**		
	(2.00)		
$\Delta Trans^{Singapore}$	0.0000661		
	(1.17)		
$\Delta Tariff^{Row}$	-0.0002156		
	(0.46)		
$\Delta Trans^{Row}$	-0.0000131		
	(0.05)		
ΔlogTFP	-0.3020171***		
	(8.40)		
ΔlogOutputshare	1.625568***		
	(30.16)		
ΔlogKLratio	0.022481***		
	(4.21)		
$\Delta logExRate^{Twei}$	-0.1597882***		
	(5.20)		
R-sq.	0.5249		
Obs.	2634		

2nd - Stage: Eq. (13)	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
	1974 - 2004(1)	**Pre FTA period(1)**	**Post FTA period(1)**
ϴs (β_s)	-0.0021227		
	(0.27)		
ϴu (β_u)	-0.0004381		
	(0.08)		
ϴr	-0.0008545		
	(0.04)		
R-sq.	0.0038		
Obs.	2634		
Wage gap			
$\beta_s - \beta_u$	-0.0016846		
	(0.15)		
	narrow		

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

(1) As U.S.-Singapore FTA started in 2004, analysis for only 1974-2004 was conducted.

<Table 9> **Regression results: Combined effect of U.S. Tariffs on imports from Canada & Mexico**

1st - Stage: Eq. (12) (Dependent Variable: $P^* = \Delta\log P$)

	1974 - 2004[(1)]	**Pre FTA period[(1)]**	**Post FTA period[(1)]**
$\Delta Tariff^{CanadaMexico}$	-0.0008278		
	(1.29)		
$\Delta Trans^{CanadaMexico}$	0.000211		
	(0.36)		
$\Delta Tariff^{Row}$	-0.000224		
	(0.60)		
$\Delta Trans^{Row}$	-0.0000432		
	(0.22)		
ΔlogTFP	-0.3007511***		
	(8.31)		
ΔlogOutputshare	1.624877***		
	(29.99)		
ΔlogKLratio	0.0221861***		
	(4.13)		
$\Delta logExRate^{Twei}$	-0.1614054***		
	(5.19)		
R-sq.	0.5254		
Obs.	2589		

2nd - Stage: Eq. (13) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	1974 - 2004[(1)]	**Pre FTA period[(1)]**	**Post FTA period[(1)]**
Ѳs (β_s)	0.0028921		
	(0.36)		
Ѳu (β_u)	-0.0019432		
	(0.34)		
Ѳr	-0.0013654		
	(0.07)		
R-sq.	0.0405		
Obs.	2589		
Wage gap			
$\beta_s - \beta_u$	0.0048353		
	(0.41)		
	expand		

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

(1) analysis only for 1974-2004 was conducted bacause of combined effect.

<Table 10> **Regression results: Combined effect of U.S. Tariffs on imports from all 6 FTA countries**

1st - Stage: Eq. (12) (Dependent Variable: P* = Δlog P)

	1974 - 2004[(1)]	**Pre FTA period[(1)]**	**Post FTA period[(1)]**
$\Delta Tariff^{AllFTA}$	-0.0004804		
	(0.84)		
$\Delta Trans^{AllFTA}$	0.0003719		
	(0.60)		
$\Delta Tariff^{Row}$	0.0000378		
	(1.01)		
$\Delta Trans^{Row}$	-0.0014322		
	(0.09)		
ΔlogTFP	-0.2998239***		
	(8.31)		
ΔlogOutputshare	1.623417***		
	(30.04)		
ΔlogKLratio	0.022709***		
	(4.26)		
$\Delta logExRate^{Twei}$	-0.1624973***		
	(5.27)		
R-sq.	0.5224		
Obs.	2630		

2nd - Stage: Eq. (13) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	1974 - 2004[(1)]	**Pre FTA period[(1)]**	**Post FTA period[(1)]**
Ɵs (β_s)	0.0010676		
	(0.13)		
Ɵu (β_u)	0.0004209		
	(0.07)		
Ɵr	-0.0009614		
	(0.05)		
R-sq.	0.0040		
Obs.	2630		
Wage gap			
$\beta_s - \beta_u$	0.0006467		
	(0.05)		
	expand		

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

(1) analysis only for 1974-2004 was conducted because of combined effect.

<Table 11> **Regression results: U.S. Tariffs on imports from all countries in the world**

1st - Stage: Eq. (12) (Dependent Variable: P* = Δlog P)

	1974 - 2004[1]	**Pre FTA period[1]**	**Post FTA period[1]**
$\Delta Tariff^{World}$	0.0000991		
	(0.23)		
$\Delta Trans^{World}$	0.0000443		
	(0.19)		
ΔlogTFP	-0.3007853***		
	(8.36)		
ΔlogOutshare	1.626422***		
	(30.16)		
ΔlogKLratio	0.0223769***		
	(4.20)		
$\Delta logExRate^{Twei}$	-0.160988***		
	(5.25)		
R-sq.	0.5240		
Obs.	2633		

2nd - Stage: Eq. (13) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	1974 - 2004[1]	**Pre FTA period[1]**	**Post FTA period[1]**
Ɵs (β_s)	-0.0002248		
	(0.03)		
Ɵu (β_u)	0.0001687		
	(0.03)		
Ɵr	0.0000794		
	(0.00)		
R-sq.	0.0171		
Obs.	2633		
Wage gap			
$\beta_s - \beta_u$	-0.0003935		
	(0.04)		
	narrow		

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.
* shows significance at 10% level.

(1) analysis only for 1974-2004 was conducted because of combined effect.

<Table 12> **Robustness Check: 3 years lag for 1974 - 2004**

1st - Stage: Eq. (14) (Dependent Variable: P* = Δlog P)

"c" is:	Canada	Mexico	CanadaMexico[1]
$\Delta Tariff^{c}$	0.000881	-0.0013069	-0.0000842
	(1.08)	(1.62)	(0.10)
$\Delta Trans^{c}$	-0.0002168	0.0011548***	0.0006647
	(0.28)	(2.47)	(0.77)
$\Delta Tariff^{Row}$	-0.000252	0.0000448	-0.0003151
	(0.45)	(1.28)	(0.58)
$\Delta Trans^{Row}$	-0.0002101	-0.0019248**	-0.000345
	(0.73)	(2.28)	(1.28)
ΔlogTFP	0.058287	0.2050024***	0.056306
	(1.09)	(2.48)	(1.06)
ΔlogOutshare	-0.1355024*	-0.3294195***	-0.1326689*
	(1.67)	(2.83)	(1.63)
ΔlogKLratio	-0.0119591	-0.0214762**	-0.0119705
	(1.51)	(2.42)	(1.51)
$\Delta logExRate^{Twei}$	0.0331522	0.0334443	0.039268
	(0.74)	(0.72)	(0.87)
R-sq.	0.0319	0.0404	0.0321
Obs.	2399	2283	2390

2nd - Stage: Eq. (15) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

"c" is:	Canada	Mexico	CanadaMexico[1]
ϴs (β_s)	0.0010453	-0.0015463	0.0000186
	(0.08)	(0.07)	(0.00)
ϴu (β_u)	0.001192	0.0004407	-0.000206
	(0.16)	(0.06)	(0.03)
ϴr	-0.0003476	0.0037174	-0.00000404
	(0.01)	(0.10)	(0.00)
R-sq.	0.0288	0.0288	0.0246
Obs.	2399	2283	2390
Wage gap			
$\beta_s - \beta_u$	-0.0001467	-0.001987	0.0002246
	(0.01)	(0.09)	(0.01)
	narrow	narrow	expand

(xxxx) shows absolute t-statistics.
* shows significance at 10% level. ** shows at 5% level. *** shows at 1% level.
[1] shows weighted average of U.S. tariff on Canada and Mexico.

<Table 13> **Robustness check: 3 years lag for 1974 - 2004**

1st - Stage: Eq. (14) (Dependent Variable: P* = Δlog P)

"c" is:	Israel	Jordan	Chile
$\Delta Tariff^{c}$	-0.0014242***	-0.0003509	-0.0002309
	(2.84)	(0.78)	(0.45)
$\Delta Trans^{c}$	0.0000207	-0.0001281	0.0000755
	(0.18)	(0.96)	(0.82)
$\Delta Tariff^{Row}$	0.0000546	-0.00015	-0.0001569
	(0.08)	(0.22)	(0.23)
$\Delta Trans^{Row}$	-0.0001713	-0.0002104	-0.0002616
	(0.51)	(0.59)	(0.75)
ΔlogTFP	0.0579546	0.0636398	0.0649373
	(1.09)	(1.20)	(1.25)
ΔlogOutshare	-0.1339084*	-0.1389025*	-0.166275**
	(1.65)	(1.71)	(2.14)
ΔlogKLratio	-0.011192	-0.0108467	-0.012771*
	(1.41)	(1.37)	(1.66)
$\Delta logExRate^{Twei}$	0.0288442	0.0282661	0.0297418
	(0.64)	(0.63)	(0.67)
R-sq.	0.0352	0.0324	0.0333
Obs.	2380	2380	2608

2nd - Stage: Eq. (15) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

"c" is:	Israel	Jordan	Chile
θs (β_s)	-0.0108853	0.0009043	-0.0004191
	(0.74)	(0.07)	(0.04)
θu (β_u)	0.0110788	-0.0008607	-0.0001735
	(1.10)	(0.11)	(0.02)
θr	0.0022194	-0.00079	-0.0001373
	(0.07)	(0.03)	(0.00)
R-sq.	0.0118	0.0019	0.0030
Obs.	2380	2380	2608
Wage gap			
$\beta_s - \beta_u$	-0.0219641	0.001765	-0.0002456
	(1.05)	(0.10)	(0.02)
	narrow	expand	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 14> **Robustness check: 3 years lag for 1974 - 2004**

1st - Stage: Eq. (14)	(Dependent Variable: P* = Δlog P)	
"c" is:	Singapore	All 6 FTA countries[(2)]
$\Delta Tariff^{c}$	-0.0008264**	-0.0000468
	(1.94)	(0.06)
$\Delta Trans^{c}$	-0.0000798	0.0004767
	(0.98)	(0.54)
$\Delta Tariff^{Row}$	-0.00000878	-0.00000967
	(0.01)	(0.19)
$\Delta Trans^{Row}$	-0.0002169	-0.0016611
	(0.61)	(0.07)
ΔlogTFP	0.0625759	0.1457728***
	(1.18)	(2.93)
ΔlogOutshare	-0.1393119*	-0.7063493***
	(1.72)	(9.33)
ΔlogKLratio	-0.0113969	0.0378954***
	(1.44)	(5.12)
$\Delta logExRate^{Twei}$	0.0259722	0.0010608
	(0.58)	(0.03)
R-sq.	0.0338	0.1888
Obs.	2380	2400
2nd - Stage: Eq. (15)	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)	
"c" is:	Singapore	All 6 FTA countries[(2)]
ϴs (β_s)	-0.0021592	0.0001809
	(0.16)	(0.02)
ϴu (β_u)	-0.0004667	-0.0002438
	(0.06)	(0.03)
ϴr	-0.0002687	-0.0000535
	(0.01)	(0.00)
R-sq.	0.0035	0.0048
Obs.	2380	2400
Wage gap		
$\beta_s - \beta_u$	-0.0016925	0.0004247
	(0.09)	(0.03)
	narrow	expand

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.
[(2)] shows weighted average of tariff on all 6 countries which have FTAs with the U.S.

<Table 15> **Robustness Check: Variable Returns to Scale for 1974 - 2004**

2nd - Stage: Eq. (17)	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
"c" is:	Canada	Mexico	CanadaMexico[1]
ϴs (β_s)	-0.0005242	-0.0000442	0.0025984
	(0.06)	(0.00)	(0.26)
ϴu (β_u)	0.0001031	-0.0001514	-0.0018802
	(0.02)	(0.03)	(0.37)
ϴr	0.0003802	0.00000945	-0.0018257
	(0.02)	(0.00)	(0.09)
RTS	-0.0000000381	0.000000235	0.000000224
	(0.01)	(0.05)	(0.04)
R-sq.	0.0253	0.0332	0.0407
Obs.	2630	2486	2589
Wage gap			
$\beta_s - \beta_u$	-0.0006273	0.0001072	0.0044786
	(0.06)	(0.01)	(0.37)
	narrow	expand	expand

2nd - Stage: Eq. (17)	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
"c" is:	Israel	Jordan	Chile
ϴs (β_s)	-0.0013381	-0.0000349	0.00000529
	(0.14)	(0.00)	(0.00)
ϴu (β_u)	0.002658	-0.0002375	-0.00000606
	(0.53)	(0.06)	(0.00)
ϴr	-0.0016486	0.0000685	0.0000218
	(0.09)	(0.00)	(0.00)
RTS	0.000000285	-0.00000000141	-0.00000000276
	(0.05)	(0.00)	(0.00)
R-sq.	0.0161	0.0010	0.0040
Obs.	2634	2634	2611
Wage gap			
$\beta_s - \beta_u$	-0.0039961	0.0002026	0.00001135
	(0.35)	(0.02)	(0.00)
	narrow	expand	expand

(xxxx) shows absolute t-statistics.

* shows significance at 10% level. ** shows at 5% level. *** shows at 1% level.

(1) shows weighted average of U.S. tariff on Canada and Mexico.

<Table 16> **Robustness Check: Variable Returns to Scale for 1974 - 2004**

2nd - Stage: Eq. (17) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	"c" is:	Singapore	All 6 FTA countries[2]
Ɵs (β_s)		-0.0017725	0.0008893
		(0.18)	(0.09)
Ɵu (β_u)		-0.0005225	0.0004616
		(0.11)	(0.09)
Ɵr		-0.0002966	-0.0012452
		(0.02)	(0.06)
RTS		-0.000000270	0.000000137
		(0.05)	(0.02)
R-sq.		0.0040	0.0041
Obs.		2634	2630
Wage gap			
$\beta_s - \beta_u$		-0.00125	0.0004277
		(0.11)	(0.03)
		narrow	expand

(xxxx) shows absolute t-statistics.
* shows significance at 10% level. ** shows at 5% level. *** shows at 1% level.
[2] shows weighted average of U.S. tariff on all 6 countries having FTAs with the U.S.

<Table 17> **Correlation with Rest Of the World: ROW (1974-2004)**

	$\Delta Tariff^{Row}$		$\Delta Trans^{Row}$
$\Delta Tariff^{Canada}$	0.3482***	$\Delta Trans^{Canada}$	0.4942***
	(12.40)		(9.95)
$\Delta Tariff^{Mexico}$	0.2704***	$\Delta Trans^{Mexico}$	0.0274***
	(12.44)		(2.59)
$\Delta Tariff^{CanadaMexico(1)}$	0.2861***	$\Delta Trans^{CanadaMexico(1)}$	0.5459***
	(8.75)		(8.95)
$\Delta Tariff^{Israel}$	0.0724***	$\Delta Trans^{Israel}$	-0.0003
	(5.44)		(0.05)
$\Delta Tariff^{Jordan}$	0.0030	$\Delta Trans^{Jordan}$	0.0021
	(0.24)		(0.29)
$\Delta Tariff^{Chile}$	0.0261*	$\Delta Trans^{chile}$	-0.0043
	(1.79)		(0.85)
$\Delta Tariff^{Singapore}$	0.0543***	$\Delta Trans^{Singapore}$	-0.0029
	(4.57)		(0.65)
$\Delta Tariff^{AllFTA(2)}$	13.7444***	$\Delta Trans^{AllFTA(2)}$	0.0072***
	(105.42)		(10.22)

(xxxx) shows absolute t-statistics.

*** shows significance at 1% level. ** shows significance at 5% level.

* shows significance at 10% level.

(1) shows weighted average of U.S. tariff on imports from Canada and Mexico.

(2) shows weighted average of U.S. tariff on imports from all 6 countries having FTAs with the U.S.

<Table 18> **Robustness Check: Change in causal variables (a)**
U.S. Tariffs on imports from Canada (1974-2004)

1st - Stage	(Dependent Variable: P* = Δlog P)		
	Eq. (18)	**Eq. (19)**	**Eq. (20)**
$\Delta Tariff^{Canada}$	0.0007321	0.0008319	0.0000917
	(0.96)	(1.05)	(0.17)
$\Delta Trans^{Canada}$	-0.0002558	-0.0002952	0.0002348
	(0.36)	(0.40)	(0.46)
$\Delta Tariff^{Row}$		-0.0003012	
		(0.55)	
$\Delta Trans^{Row}$		0.0000645	
		(0.23)	
ΔlogTFP			-0.3006509***
			(8.36)
ΔlogOutshare			1.623079***
			(30.13)
ΔlogKLratio			0.0225624***
			(4.24)
$\Delta logExRate^{Twei}$			-0.1604702***
			(5.23)
R-sq.	0.0253	0.0256	0.5216
Obs.	2666	2642	2654

2nd - Stage	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
	Eq. (13)	**Eq. (13)**	**Eq. (13)**
ϴs (β_s)	-0.0025305	-0.0029221	-0.0003176
	(0.76)	(0.79)	(0.04)
ϴu (β_u)	0.0005297	0.0006148	0.0000631
	(0.24)	(0.22)	(0.01)
ϴr	0.0013666	0.0015645	0.0001683
	(0.66)	(0.71)	(0.01)
R-sq.	0.0254	0.0254	0.0251
Obs.	2666	2642	2654
Wage gap			
β_s - β_u	-0.0030602	-0.0035369	-0.0003807
	(0.65)	(0.63)	(0.04)
	narrow	narrow	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 19> **Robustness Check: Change in causal variables (a)**

U.S. Tariffs on imports from Mexico (1974-2004)

1st - Stage	(Dependent Variable: $P^* = \Delta \log P$)		
	Eq. (18)	**Eq. (19)**	**Eq. (20)**
$\Delta Tariff^{Mexico}$	-0.0003652	-0.0004961	-0.0004515
	(0.50)	(0.66)	(0.62)
$\Delta Trans^{Mexico}$	-0.0000344	-0.0000479	-0.0000539
	(0.08)	(0.11)	(0.13)
$\Delta Tariff^{Row}$		0.0004352	
		(0.66)	
$\Delta Trans^{Row}$		0.0005479	
		(0.70)	
ΔlogTFP			0.1150562
			(1.47)
ΔlogOutshare			-0.1558448
			(1.43)
ΔlogKLratio			-0.0079703
			(0.93)
$\Delta logExRate^{Twei}$			-0.0464052
			(1.02)
R-sq.	0.0309	0.0313	0.0323
Obs.	2429	2429	2416

2nd - Stage	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
	Eq. (13)	**Eq. (13)**	**Eq. (13)**
Θs (β_s)	-0.0008492	-0.0011537	-0.0010511
	(0.40)	(0.47)	(0.22)
Θu (β_u)	0.0009919	0.0013475	0.0012265
	(0.34)	(0.43)	(0.36)
Θr	-0.0003048	-0.0004141	-0.0003818
	(0.18)	(0.20)	(0.13)
R-sq.	0.0387	0.0387	0.0388
Obs.	2429	2429	2416
Wage gap			
$\beta_s - \beta_u$	-0.0018411	-0.0025012	-0.0022776
	(0.44)	(0.54)	(0.32)
	narrow	narrow	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.

** shows significance at 5% level. *** shows significance at 1% level.

<Table 20> **Robustness Check: Change in causal variables (a)**
U.S. Tariffs on imports from Canada & Mexico (1974-2004)

1st - Stage (Dependent Variable: P* = Δlog P)

	Eq. (18)	Eq. (19)	Eq. (20)
$\Delta Tariff^{CanadaMexico}$	0.0000687	-0.0006813	-0.0003265
	(0.08)	(0.74)	(0.57)
$\Delta Trans^{CanadaMexico}$	0.0000234	-0.0000437	0.0002327
	(0.03)	(0.05)	(0.41)
$\Delta Tariff^{Row}$		-0.0003357	
		(0.62)	
$\Delta Trans^{Row}$		0.0000548	
		(0.19)	
ΔlogTFP			-0.3004133***
			(8.33)
ΔlogOutshare			1.626202***
			(30.10)
ΔlogKLratio			0.0226395***
			(4.24)
$\Delta logExRate^{Twei}$			-0.1620528***
			(5.26)
R-sq.	0.0250	0.0262	0.5237
Obs.	2634	2601	2622

2nd - Stage (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	Eq. (13)	Eq. (13)	Eq. (13)
ϴs (β_s)	-0.000337	0.0023712	0.0016081
	(0.08)	(0.63)	(0.20)
ϴu (β_u)	0.0002558	-0.0016062	-0.0012139
	(0.07)	(0.52)	(0.22)
ϴr	0.0001083	-0.001134	-0.0005108
	(0.05)	(0.43)	(0.03)
R-sq.	0.0253	0.0408	0.0250
Obs.	2634	2601	2622
Wage gap			
$\beta_s - \beta_u$	-0.0005928	0.0039774	0.002822
	(0.08)	(0.60)	(0.24)
	narrow	expand	expand

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 21> **Robustness Check: Change in causal variables (a)**
U.S. Tariffs on imports from Israel (1974-2004)

1st - Stage	(Dependent Variable: P* = Δlog P)		
	Eq. (18)	**Eq. (19)**	**Eq. (20)**
$\Delta Tariff^{Israel}$	-0.001316***	-0.0013293***	-0.0004125
	(2.74)	(2.76)	(1.18)
$\Delta Trans^{Israel}$	0.0000947	0.0000948	-0.0000778
	(0.94)	(0.94)	(1.07)
$\Delta Tariff^{Row}$		-0.0001113	
		(0.16)	
$\Delta Trans^{Row}$		0.0001382	
		(0.42)	
ΔlogTFP			-0.3588691***
			(9.88)
ΔlogOutshare			1.689045***
			(31.10)
ΔlogKLratio			0.0266703***
			(5.09)
$\Delta logExRate^{Twei}$			-0.1347773***
			(4.61)
R-sq.	0.0249	0.0282	0.4864
Obs.	3092	2648	3078

2nd - Stage	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
	Eq. (13)	**Eq. (13)**	**Eq. (13)**
ϴs (β_s)	-0.0020943	-0.0031872	-0.0006243
	(0.42)	(0.51)	(0.10)
ϴu (β_u)	0.0061558	0.0083155	0.001879
	(1.46)	(1.54)	(0.44)
ϴr	-0.0031637	-0.0035331	-0.000936
	(0.98)	(0.93)	(0.05)
R-sq.	0.0151	0.0156	0.0153
Obs.	3092	2648	3078
Wage gap			
$\beta_s - \beta_u$	-0.0082501	-0.0115027	-0.0025033
	(1.07)	(1.15)	(0.29)
	narrow	narrow	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 22> **Robustness Check: Change in causal variables (a) U.S. Tariffs on imports from Jordan (1974-2004)**

1st - Stage	(Dependent Variable: $P^* = \Delta\log P$)		
	Eq. (18)	**Eq. (19)**	**Eq. (20)**
$\Delta Tariff^{Jordan}$	-0.0005234	-0.0005219	-0.000143
	(1.14)	(1.13)	(0.43)
$\Delta Trans^{Jordan}$	0.0001906	0.0001901	0.0000273
	(1.39)	(1.39)	(0.27)
$\Delta Tariff^{Row}$		-0.000298	
		(0.44)	
$\Delta Trans^{Row}$		0.0002004	
		(0.57)	
ΔlogTFP			-0.3598173***
			(9.90)
ΔlogOutshare			1.690295***
			(31.16)
ΔlogKLratio			0.0266582***
			(5.08)
$\Delta logExRate^{Twei}$			-0.1332842***
			(4.55)
R-sq.	0.0232	0.0262	0.4859
Obs.	3092	2648	3078

2nd - Stage	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
	Eq. (13)	**Eq. (13)**	**Eq. (13)**
Θs (β_s)	-0.0001743	-0.0001411	-0.0000483
	(0.08)	(0.05)	(0.01)
Θu (β_u)	-0.0007235	-0.0009191	-0.0001979
	(0.44)	(0.44)	(0.05)
Θr	0.0002162	0.0002523	0.0000597
	(0.16)	(0.13)	(0.00)
R-sq.	0.0010	0.001	0.0010
Obs.	3092	2648	3078
Wage gap			
$\beta_s - \beta_u$	0.0005492	0.000778	0.0001496
	(0.18)	(0.18)	(0.02)
	expand	expand	expand

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 23> **Robustness Check: Change in causal variables (a)**
U.S. Tariffs on imports from Chile (1974-2004)

1st - Stage	(Dependent Variable: P* = Δlog P)		
	Eq. (18)	**Eq. (19)**	**Eq. (20)**
$\Delta Tariff^{Chile}$	-0.0002181	-0.0001978	-0.00000739
	(0.42)	(0.38)	(0.02)
$\Delta Trans^{Chile}$	-0.0000212	-0.0000205	-0.0000661
	(0.23)	(0.22)	(0.98)
$\Delta Tariff^{Row}$		-0.000306	
		(0.45)	
$\Delta Trans^{Row}$		0.0001944	
		(0.55)	
ΔlogTFP			-0.3606092***
			(9.92)
ΔlogOutshare			1.691824***
			(31.19)
ΔlogKLratio			0.0265859***
			(5.07)
$\Delta logExRate^{Twei}$			-0.13361***
			(4.56)
R-sq.	0.0225	0.0256	0.4860
Obs.	3092	2625	3078

2nd - Stage	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
	Eq. (13)	**Eq. (13)**	**Eq. (13)**
ϴs (β_s)	0.0000669	0.0000922	0.00000213
	(0.08)	(0.05)	(0.00)
ϴu (β_u)	-0.0002342	-0.0002613	-0.00000818
	(0.30)	(0.23)	(0.00)
ϴr	0.0008459	0.0008025	0.0000293
	(0.38)	(0.30)	(0.00)
R-sq.	0.0030	0.0035	0.0031
Obs.	3092	2625	3078
Wage gap			
β_s - β_u	0.0003011	0.0003535	0.00001031
	(0.23)	(0.13)	(0.00)
	expand	expand	expand

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 24> **Robustness Check: Change in causal variables (a)**
U.S. Tariffs on imports from Singapore (1974-2004)

1st - Stage (Dependent Variable: P* = Δlog P)

	Eq. (18)	**Eq. (19)**	**Eq. (20)**
$\Delta Tariff^{Singapore}$	-0.0010123**	-0.0010096**	-0.0006092**
	(2.40)	(2.38)	(2.00)
$\Delta Trans^{Singapore}$	0.0001046	0.0001054	0.0000688
	(1.29)	(1.30)	(1.17)
$\Delta Tariff^{Row}$		-0.0001702	
		(0.25)	
$\Delta Trans^{Row}$		0.0001943	
		(0.56)	
ΔlogTFP			-0.3602565***
			(9.92)
ΔlogOutshare			1.689493***
			(31.17)
ΔlogKLratio			0.0269***
			(5.13)
$\Delta logExRate^{Twei}$			-0.1340169***
			(4.58)
R-sq.	0.0245	0.0277	0.4866
Obs.	3092	2648	3078

2nd - Stage (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	Eq. (13)	**Eq. (13)**	**Eq. (13)**
θs (β_s)	-0.0029814	-0.0033991	-0.0018989
	(0.66)	(0.61)	(0.28)
θu (β_u)	-0.0010006	-0.0008828	-0.0005399
	(0.32)	(0.23)	(0.13)
θr	-0.001511	-0.0016806	-0.0007841
	(0.53)	(0.50)	(0.04)
R-sq.	0.0032	0.0038	0.0032
Obs.	3092	2648	3078
Wage gap			
$\beta_s - \beta_u$	-0.0019808	-0.0025163	-0.001359
	(0.31)	(0.32)	(0.15)
	narrow	narrow	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.

** shows significance at 5% level. *** shows significance at 1% level.

<Table 25> **Robustness Check: Change in causal variables (a)**
U.S. Tariffs on imports from 6 FTA countries (1974-2004)

1st - Stage	(Dependent Variable: P* = Δlog P)		
	Eq. (18)	**Eq. (19)**	**Eq. (20)**
$\Delta Tariff^{AllFTA}$	0.0001746	0.0002144	0.0000391
	(0.48)	(0.26)	(0.15)
$\Delta Trans^{AllFTA}$	0.0003074	0.0003443	0.0003877
	(0.35)	(0.39)	(0.63)
$\Delta Tariff^{Row}$		-0.00000303	
		(0.06)	
$\Delta Trans^{Row}$		-0.005429	
		(0.23)	
ΔlogTFP			-0.300451***
			(8.33)
ΔlogOutshare			1.623841***
			(30.06)
ΔlogKLratio			0.0226465***
			(4.25)
$\Delta logExRate^{Twei}$			-0.1612425***
			(5.24)
R-sq.	0.0250	0.0250	0.5222
Obs.	2642	2642	2630

2nd - Stage	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
	Eq. (13)	**Eq. (13)**	**Eq. (13)**
ϴs (β_s)	-0.0003833	-0.0004708	-0.0000869
	(0.15)	(0.11)	(0.01)
ϴu (β_u)	-0.0001541	-0.0001893	-0.0000343
	(0.07)	(0.05)	(0.01)
ϴr	0.0003476	0.000427	0.0000782
	(0.18)	(0.20)	(0.00)
R-sq.	0.0041	0.0041	0.0040
Obs.	2642	2642	2630
Wage gap			
$\beta_s - \beta_u$	-0.0002292	-0.0002815	-0.0000526
	(0.05)	(0.04)	(0.00)
	narrow	narrow	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 26> **Robustness Check: Change in causal variables (b)**

U.S. Tariffs on imports from Canada

1st - Stage: Eq. (21) (Dependent Variable: $P^* = \Delta\log P$)`

	1974 - 2004	**Pre FTA period**	**Post FTA period**
$\Delta Tariff^{Canada}$	0.0005542	0.0000891	0.0014906
	(0.85)	(0.12)	(0.96)
$\Delta Trans^{Canada}$	0.000514	0.0015441**	-0.0009916
	(0.94)	(2.06)	(1.21)
$\Delta Tariff^{Row}$	-0.0003783	-0.0006722	-0.0004078
	(0.97)	(0.83)	(0.96)
$\Delta Trans^{Row}$	-0.00000394	0.0003885	0.0001033
	(0.02)	(1.15)	(0.41)
$\Delta logImpprice^{Canada}$	0.0277398***	0.0326397***	0.0198267***
	(6.49)	(4.88)	(3.62)
ΔlogTFP	-0.2993227***	-0.6986917***	-0.1987446***
	(8.37)	(8.48)	(5.10)
ΔlogOutputshare	1.622394***	2.074458***	1.540937***
	(30.23)	(18.75)	(23.27)
ΔlogKLratio	0.0220493***	0.0530356***	0.0291601***
	(4.15)	(5.42)	(4.22)
$\Delta logExRate^{Twei}$	-0.1484841***	-0.1734906***	-0.0509963
	(4.84)	(4.22)	<1.08>
R-sq.	0.5319	0.6026	0.4991
Obs.	2593	1106	1506

2nd - Stage: Eq. (13) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	1974 - 2004	**Pre FTA period**	**Post FTA period**
ϴs ($\hat{w}_s$)	-0.0015123	-0.0003278	0.0006697
	(0.18)	(0.01)	(0.04)
ϴu ($\hat{w}_u$)	-0.0000396	0.0003005	-0.0081325
	(0.01)	(0.02)	(0.42)
ϴr	0.0009463	0.0004609	-0.0003589
	(0.05)	(0.01)	(0.01)
R-sq.	0.0521	0.0511	0.1676
Obs.	2593	1106	1506
Wage gap			
$\hat{w}_s - \hat{w}_u$	-0.0014727	-0.0006283	0.0088022
	(0.12)	(0.02)	(0.26)
	narrow	narrow	expand

(xxxx) shows absolute t-statistics. * shows significance at 10% level.

** shows significance at 5% level. *** shows significance at 1% level.

<Table 27> **Robustness Check: Change in causal variables (b)**

U.S. Tariffs on imports from Mexico

1st - Stage: Eq. (21) (Dependent Variable: P* = Δlog P)

	1974 - 2004	**Pre FTA period**	**Post FTA period**
$\Delta \text{Tariff}^{\text{Mexico}}$	-0.0000434	-0.0011652*	0.000279
	(0.05)	(1.86)	(0.14)
$\Delta \text{Trans}^{\text{Mexico}}$	-0.0004898	0.0003781	0.0002449
	(1.08)	(1.09)	(0.37)
$\Delta \text{Tariff}^{\text{Row}}$	0.0001862	-0.0002939	-0.0048368*
	(0.27)	(0.61)	(1.89)
$\Delta \text{Trans}^{\text{Row}}$	0.0009755	0.0002433	-0.0023653
	(1.17)	(0.39)	(1.58)
$\Delta \text{logImpprice}^{\text{Mexico}}$	0.0014123	0.0131925***	0.0113063**
	(0.41)	(4.87)	(2.38)
ΔlogTFP	0.1098191	-0.7226061***	-0.9392693***
	(1.38)	(10.98)	(10.12)
ΔlogOutputshare	-0.1516217	2.143814***	2.573161***
	(1.37)	(23.87)	(18.87)
ΔlogKLratio	-0.0073443	0.0315765***	0.1038383***
	(0.83)	(4.61)	(8.50)
$\Delta \text{logExRate}^{\text{Twei}}$	-0.04348	-0.1719711***	-0.038898
	(0.94)	(4.53)	(0.75)
R-sq.	0.033	0.6017	0.5472
Obs.	2351	1490	948

2nd - Stage: Eq. (13) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	1974 - 2004	**Pre FTA period**	**Post FTA period**
Θs ($\hat{w}_s$)	-0.0000346	0.0033874	0.0012084
	(0.01)	(0.14)	(0.03)
Θu ($\hat{w}_u$)	0.0000818	0.0008844	-0.0008374
	(0.03)	(0.08)	(0.02)
Θr	-0.0000456	-0.0045791	-0.0000609
	(0.01)	(0.19)	(0.00)
R-sq.	0.0407	0.0436	0.1088
Obs.	2351	1490	948
Wage gap			
$\hat{w}_s - \hat{w}_u$	-0.0001164	0.002503	0.0020458
	(0.02)	(0.11)	(0.04)
	narrow	expand	expand

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 28> **Robustness Check: Change in causal variables (b)**
U.S. tariffs on imports from Canada & Mexico

1st - Stage: Eq. (21) (Dependent Variable: P* = Δlog P)

	1974 - 2004	**Pre FTA period**	**Post FTA period**
$\Delta Tariff^{CanadaMexico}$	-0.0007883	-0.0009213	-0.0012167
	(1.24)	(1.15)	(0.97)
$\Delta Trans^{CanadaMexico}$	0.0000218	0.0011465	-0.0014792*
	(0.04)	(1.34)	(1.77)
$\Delta Tariff^{Row}$	-0.0002903	-0.0005954	-0.000281
	(0.78)	(0.73)	(0.71)
$\Delta Trans^{Row}$	0.0000195	0.0003752	0.0002128
	(0.10)	(1.22)	(0.83)
$\Delta logImpprice^{CanadaMexico}$	0.0217361***	0.0212639***	0.0184951***
	(5.84)	(3.95)	(3.43)
ΔlogTFP	-0.2996673***	-0.7119268***	-0.1995993***
	(8.34)	(8.55)	(5.12)
ΔlogOutputshare	1.620261***	2.090813***	1.537542***
	(30.10)	(18.71)	(23.23)
ΔlogKLratio	0.0224483***	0.0547542***	0.0281276***
	(4.21)	(5.55)	(4.06)
$\Delta logExRate^{Twei}$	-0.1579177***	-0.1847195***	-0.055331
	(5.11)	(4.43)	(1.17)
R-sq.	0.5318	0.5989	0.5016
Obs.	2589	1114	1494

2nd - Stage: Eq. (13) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	1974 - 2004	**Pre FTA period**	**Post FTA period**
ϴs ($\hat{w}_s$)	0.0027538	0.005972	-0.0033439
	(0.31)	(0.15)	(0.19)
ϴu ($\hat{w}_u$)	-0.0018503	-0.0076363	0.0071413
	(0.30)	(0.48)	(0.37)
ϴr	-0.0013001	-0.0039014	0.0006285
	(0.07)	(0.12)	(0.02)
R-sq.	0.0405	0.0479	0.1009
Obs.	2589	1114	1494
Wage gap			
$\hat{w}_s - \hat{w}_u$	0.0046041	0.0136083	-0.0104852
	(0.34)	(0.31)	(0.31)
	expand	expand	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 29> **Robustness Check: Change in causal variables (b)**

U.S. Tariffs on imports from Israel

1st - Stage: Eq. (21) (Dependent Variable: P* = Δlog P)

	1974 - 2004	**Pre FTA period**	**Post FTA period**
$\Delta Tariff^{Israel}$	-0.0005528	-0.0001048	-0.001141
	(1.43)	(0.22)	(1.46)
$\Delta Trans^{Israel}$	-0.0000838	-0.0002076**	0.0002067
	(1.03)	(2.06)	(1.34)
$\Delta Tariff^{Row}$	-0.0005507	-0.0008191	-0.0024059
	(0.51)	(0.61)	(1.14)
$\Delta Trans^{Row}$	-0.0000136	0.0022847*	-0.0001301
	(0.04)	(1.65)	(0.38)
$\Delta logImpprice^{Israel}$	0.0059148***	0.0094252**	0.005455**
	(2.88)	(2.46)	(2.19)
ΔlogTFP	-0.2895722***	-0.9966152***	-0.1967036***
	(7.78)	(8.64)	(4.98)
ΔlogOutputshare	1.670914***	2.591392***	1.569745***
	(27.51)	(15.17)	(23.39)
ΔlogKLratio	0.0282459***	0.0837573***	0.0256681***
	(4.62)	(5.80)	(3.62)
$\Delta logExRate^{Twei}$	-0.1123781***	-0.3977224***	-0.0508093
	(3.40)	(4.55)	(1.37)
R-sq.	0.504	0.4998	0.5337
Obs.	2019	623	1434

2nd - Stage: Eq. (13) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	1974 - 2004	"c" is Israel	"c" is Israel
ϴs ($\hat{w}_s$)	0.0000124	-0.0005414	-0.0013295
	(0.00)	(0.01)	(0.08)
ϴu ($\hat{w}_u$)	0.0034872	-0.0003056	0.0096083
	(0.52)	(0.00)	(0.75)
ϴr	-0.0023161	-0.0011534	-0.003533
	(0.11)	(0.03)	(0.12)
R-sq.	0.0334	0.0303	0.1033
Obs.	2019	623	1434
Wage gap			
$\hat{w}_s - \hat{w}_u$	-0.0034748	-0.0002358	-0.0109378
	(0.23)	(0.00)	(0.64)
	narrow	narrow	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 30> **Robustness Check: Change in causal variables (b)**

U.S. Tariffs on imports from Jordan

1st - Stage: Eq. (21)	(Dependent Variable: P* = Δlog P)		
	1974 - 2004	**Pre FTA period**	**Post FTA period**
$\Delta Tariff^{Jordan}$	-0.000061	-0.0000487	-0.0008668
	(0.16)	(0.14)	(0.20)
$\Delta Trans^{Jordan}$	0.000065	0.0000993	-0.0014744*
	(0.49)	(0.77)	(1.84)
$\Delta Tariff^{Row}$	-0.0001837	0.000452	0.0169662
	(0.04)	(0.11)	(0.70)
$\Delta Trans^{Row}$	-0.0035741	-0.0022205	-0.0001708
	(1.24)	(0.80)	(0.01)
$\Delta logImpprice^{Jordan}$	-0.0014118	-0.0007994	-0.0369046
	(0.45)	(0.27)	(1.32)
ΔlogTFP	-0.7488362***	-1.05973***	-0.3278862
	(6.46)	(8.22)	(0.76)
ΔlogOutputshare	2.068942***	2.539853***	1.549549**
	(12.00)	(13.31)	(2.73)
ΔlogKLratio	0.0746618***	0.0923011***	0.1417141
	(3.26)	(3.87)	(1.57)
$\Delta logExRate^{Twei}$	-0.001967	-0.0298396	-0.0969267
	(0.03)	(0.40)	(0.46)
R-sq.	0.6044	0.676	0.8591
Obs.	345	304	124
2nd - Stage: Eq. (13)	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
	1974 - 2004	"c" is Jordan	"c" is Jordan
ϴs ($\hat{w}_s$)	-0.0004398	-0.0006523	-0.0721564
	(0.01)	(0.01)	(0.05)
ϴu ($\hat{w}_u$)	-0.0000495	-0.0000116	0.0351113
	(0.00)	(0.00)	(0.03)
ϴr	-0.0001801	-0.0003717	-0.0299703
	(0.00)	(0.01)	(0.05)
R-sq.	0.0557	0.054	0.3338
Obs.	345	304	124
Wage gap			
$\hat{w}_s - \hat{w}_u$	-0.0003903	-0.0006407	-0.1072677
	(0.01)	(0.01)	(0.04)
	narrow	narrow	narrow

(xxxx) shows absolute t-statistics. * shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

<Table 31> **Robustness Check: Change in causal variables (b)**

U.S. Tariffs on imports from Chile

1st - Stage: Eq. (21)	(Dependent Variable: P* = Δlog P)		
	1974 - 2004	**Pre FTA period(1)**	**Post FTA period(1)**
$\Delta Tariff^{Chile}$	0.0002937		
	(0.46)		
$\Delta Trans^{Chile}$	0.0000512		
	(0.45)		
$\Delta Tariff^{Row}$	-0.0001409		
	(0.09)		
$\Delta Trans^{Row}$	-0.0012372		
	(0.91)		
$\Delta logImpprice^{Chile}$	0.0011292		
	(0.44)		
ΔlogTFP	-0.5431489***		
	(6.69)		
ΔlogOutputshare	1.892728***		
	(16.98)		
ΔlogKLratio	0.0275813***		
	(3.57)		
$\Delta logExRate^{Twei}$	-0.0460752		
	(0.92)		
R-sq.	0.6418		
Obs.	930		
2nd - Stage: Eq. (13)	(Dependent variable: Δlog P induced by Δtariff from 1st-Stage)		
	1974 - 2004	**Pre FTA period(1)**	**Post FTA period(1)**
ϴs ($\hat{w}_s$)	-0.0013042		
	(0.05)		
ϴu ($\hat{w}_u$)	0.0002588		
	(0.02)		
ϴr	-0.0016045		
	(0.05)		
R-sq.	0.073		
Obs.	930		
Wage gap ($\hat{w}_s$ - $\hat{w}_u$)	-0.001563		
	(0.06)	(xxxx) shows absolute t-statistics.	
	narrow	* shows significance at 10% level.	

** shows significance at 5% level. *** shows significance at 1% level.

(1) As U.S.-Chile FTA started in 2002, analysis for only 1974-2004 was conducted.

<Table 32> **Robustness Check: Change in causal variables (b)**

U.S. Tariffs on imports from Singapore

1st - Stage: Eq. (21) (Dependent Variable: $P^* = \Delta \log P$)

	1974 - 2004	**Pre FTA period[1]**	**Post FTA period[1]**
$\Delta Tariff^{Singapore}$	-0.0009917**		
	(2.34)		
$\Delta Trans^{Singapore}$	0.0001007		
	(1.02)		
$\Delta Tariff^{Row}$	-0.0003738		
	(0.75)		
$\Delta Trans^{Row}$	-0.0009391		
	(0.82)		
$\Delta logImpprice^{Singapore}$	0.0045347**		
	(2.36)		
ΔlogTFP	-0.5093498***		
	(10.70)		
ΔlogOutputshare	1.899086***		
	(25.16)		
ΔlogKLratio	0.0396028***		
	(5.39)		
$\Delta logExRate^{Twei}$	-0.0925225***		
	(2.56)		
R-sq.	0.452		
Obs.	1657		

2nd - Stage: Eq. (13) (Dependent variable: Δlog P induced by Δtariff from 1st-Stage)

	1974 - 2004	**Pre FTA period[1]**	**Post FTA period[1]**
ϴs ($\hat{w}_s$)	-0.0041527		
	(0.20)		
ϴu ($\hat{w}_u$)	0.0018448		
	(0.28)		
ϴr	-0.0032046		
	(0.09)		
R-sq.	0.0547		
Obs.	1657		
Wage gap ($\hat{w}_s - \hat{w}_u$)	-0.0059975		
	(0.25)		
	narrow		

(xxxx) shows absolute t-statistics.
* shows significance at 10% level.
** shows significance at 5% level. *** shows significance at 1% level.

[1] As U.S.-Singapore FTA started in 2002, analysis for only 1974-2004 was conducted.

Appendix I: Mandated wage methodology

Stolper and Samuelson (1941), using two factors (labor and capital) and two commodities (watch and wheat), shows that not only a tariff on labor intensive imports raises the wage relative to the prices of other factors (rental price of capital) but also the wage rises relative to the prices of all goods and rental price of capital falls relative to the prices of all goods. At this core of Stolper-Samuelson theorem is the zero profit condition that equates each product price with average cost that must hold in perfectly competitive market (Deardorff 1994, Slaughter 2000). The zero profit conditions are represented as;

$$p = A^T w \qquad \text{(A-1)}$$

where p is J x 1 vector of J domestic product prices, w is I x 1 vector of I domestic factor prices, and A^T is J x I technology matrix, whose a_{ij} element is the number of units of factor i required to produce one unit of product j. Total differentiation of (A-1) yields, holding technology constant;

$$\hat{p} = \theta \hat{w} \qquad \text{(A-2)}$$

where, ^ (hat) means percentage change denoted by $\hat{p} = \dfrac{dp}{p} = d(\log p)$ from Jones algebra (Jones 1965). So, $\hat{p}$ is J x 1 vector of J domestic product price changes, $\hat{w}$ is I x 1 vector of I domestic factor price changes, and θ is J x I matrix showing share of factor among unit cost, whose ij element (θ_{ij}) is the share of factor i in the average cost incurred to produce one unit of product j, that is, $\theta_{ij} = \dfrac{a_{ij} w_i}{p_j}$, where $a_{ij} = \dfrac{\partial c_j}{\partial w_i}$ is the amount of factor i required to produce one unit of commodity j.

If θ is square and invertible, we can solve for $\hat{w}$ on (A-2) such as

$$\hat{w} = \theta^{-1}\hat{p} \qquad \text{(A-3)}$$

However, θ is not usually square since numbers of factors and numbers of commodities are not equal and so it is not invertible in most of the cases. Therefore, we can not use (A-3) to figure out $\hat{w}$. Alternatively, we may estimate the zero profit condition (A-2) directly by constructing

$$\hat{p} = \theta\beta + \varepsilon \qquad \text{(A-4)}$$

where, β is I x 1 vector to be estimated, and ε is an error term.

Mandated wage equation is the method to estimate the change of factor prices using equation (A-4). In other words, we regress the vector of product price changes ($\hat{p}$) across time on the factor share matrix (θ). Then, we get the estimated coefficient ($\tilde{\beta}$) of factor share matrix (θ), which is the change in factor prices that we estimate. The result is

$$\tilde{\hat{p}} = \theta\tilde{\beta} \qquad \text{(A-5)}$$

where, $\tilde{\beta}$ shows estimated value of change in factor prices ($\hat{w}$). Therefore, we can interpret $\tilde{\beta}$ as the change in factor prices that are mandated (explained) by the change in product prices.

Leamer (1998), Feenstra and Hanson (1999), Baldwin and Cain (2000), Haskel and Slaughter (2003), Robertson (2004), and others have used and expanded this method to analyze the impact of international trade on wages.

Appendix II: ASM-HK code

ASM-HK code is NAICS (and ASM-CODE) related my own classification code.

(1) How I have made ASM-HK.

The procedure to create ASM-HK is as follows:

Step 1: To create NAICS-HK1 from the concordance between SIC 87 and NAICS

SIC 87 NAICS NAICS-HK1

(1) 2047 → → 311111 ==> 311111

(2) 2048 → → 311119 ==> 311GHI

→ → 311611 ==> 311GHI

(3) 2011 → → 311611 ==> 311GHI

(4) 2013 → → 311612 ==> 311ABC

→ → 311613 ==> 311ABC

Step 2: To create NAICS-HK by adding SIC 72

SIC 72 SIC 87 NAICS NAICS-HK1 NAICS-HK

(a) 2047 → → 2047 → → 311111 ==> 311111 ====> 311GHI

→ → 2048 → → 311119 ==> 311GHI ====> 311GHI

→ → 311611 ==> 311GHI ====> 311GHI

(b) 2048 → → 2048 → → 311119 ==> 311GHI ====> 311GHI

→ → 311611 ==> 311GHI ====> 311GHI

(c) 2011 → → 2011 → → 311611 ==> 311GHI ====> 311GHI

(d) 2013 → → 2013 → → 311612 ==> 311ABC ====> 311ABC

→ → 311613 ==> 311ABC ====> 311ABC

Step 3: To create ASM-HK code by adding ASM-CODE

SIC 72 SIC 87 NAICS NAICS-HK ASM-CODE ASM-HK

(a) 2047 → → 2047 → → 311111 (=> 311GHI) → → 311111 → → 311XYZ

→ → 2048 → → 311119 (=> 311GHI) → → 311119 → → 311XYZ

→ → 311611 (=> 311GHI) → → 31161N → → 311XYZ

(b) 2048 → → 2048 → → 311119 (=> 311GHI) → → 311119 → → 311XYZ

→ → 311611 (=> 311GHI) → → 31161N → → 311XYZ

(c) 2011 → → 2011 → → 311611 (=> 311GHI) → → 31161N → → 311XYZ

(d) 2013 → → 2013 → → 311612 (=> 311ABC) → → 31161N → → 311XYZ

→ → 311613 (=> 311ABC) → → 31161N → → 311XYZ

(2) Now, classification code in all data can be replaced with ASM-HK as follows.

Industrial data:

1974 – 1986: SIC 72 → → ASM-HK

1987 – 1996: SIC 87 → → ASM-HK

1997 – 2001: NAICS → → ASM-HK

2002 – 2004: ASM code → → ASM-HK

Import data:

1974 – 1988: TSUSA → → SIC 72 → → ASM-HK

1989 – 2004: HTS → → SIC 87 → → ASM-HK

Appendix III: Description of ASM-HK code

	ASM-HK	Description
1	113310	Logging
2	31122X	*311221* Wet corn milling
		311222 Soybean processing
		311223 Other oilseed processing
		311225 Fats and oils refining and blending
3	311313	Beet sugar manufacturing
4	31131X	*311311* Sugarcane mills
		311312 Cane sugar refining
5	311513	Cheese manufacturing
6	311520	Ice cream and frozen dessert manufacturing
7	311XYZ	*311111* Dog and cat food manufacturing
		311119 Other animal food processing
		311611 Animal (except poultry) slaughtering
		311612 Meat processed from carcasses
		311613 Rendering and meat byproduct processing
		311711 Seafood canning
		311712 Fresh and frozen seafood processing
8	31211X	*312111* Soft drink manufacturing
		312112 Bottled water manufacturing
		312113 Ice manufacturing
9	3121X0	*312130* Wineries
		312140 Distilleries
10	3122XY	*312210* Tobacco stemming and redrying
		312221 Cigarette manufacturing
		312229 Other tobacco product manufacturing
11	314110	Carpet and rag mills
12	314992	Tire cord and tire fabric mills
13	31621X	*316211* Rubber and plastics footwear manufacturing
		316212 House slipper manufacturing
		316213 Men's footwear (except athletic) manufacturing
		316214 Women's footwear (except athletic) manufacturing
		316219 Other footwear manufacturing
14	32121X	*321213* Engineered wood member (except truss) manufacturing
		321214 Truss manufacturing
15	32121Y	*321211* Hardwood veneer and plywood manufacturing
		321212 Softwood veneer and plywood manufacturing
16	321991	Manufactured home (mobile home) manufacturing
17	321992	Prefabricated wood building manufacturing
18	32412X	*324121* Asphalt paving mixture and block manufacturing
		324122 Asphalt shingle and coating materials manufacturing
19	324191	Petroleum lubricating oil and grease manufacturing
20	325181	Alkalis and chlorine manufacturing

21	325211		Plastics material and resin manufacturing
22	325212		Synthetic rubber manufacturing
23	32522X	*325221*	Cellulosic organic fiber manufacturing
		325222	Noncellulosic organic fiber manufacturing
24	325311		Nitrogenous fertilizer manufacturing
25	325312		Phosphatic fertilizer manufacturing
26	325314		Fertilizer (mixing only) manufacturing
27	325320		Pesticide and other agricultural chemical manufacturing
28	325411		Medicinal and botanical manufacturing
29	32541X	*325412*	Pharmaceutical preparation manufacturing
		325413	In - vitro diagnostic substance manufacturing
30	325520		Adhesive manufacturing
31	3256XY	*325611*	Soap and other detergent manufacturing
		325612	Polish and other sanitation goods manufacturing
		325613	Surface active agent manufacturing
		325620	Toilet preparation manufacturing
32	325910		Printing ink manufacturing
33	325920		Explosives manufacturing
34	326211		Tire manufacturing (except retreading)
35	326220		Rubber and plastics hoses and belting manufacturing
36	327111		Vitreous china plumbing fixture and china and earthenware bathroom accessories manufacturing
37	327122		Ceramic wall and floor tile manufacturing
38	327123		Other structural clay product manufacturing
39	32712X	*327124*	Clay refractory manufacturing
		327125	Nonclay refractory manufacturing
40	327211		Flat glass manufacturing
41	327212		Other pressed and blown glass and glassware manufacturing
42	327213		Glass container manufacturing
43	327215		Glass product manufacturing made of purchased glass
44	327310		Cement manufacturing
45	327320		Ready - mix concrete manufacturing
46	327410		Lime manufacturing
47	327991		Cut stone and stone product manufacturing
48	327993		Mineral wool manufacturing
49	32799A	*212324*	Kaolin and ball clay mining
		212325	Clay and ceramic and refractory minerals mining
		212393	Other chemical and fertilizer mineral mining
		212399	All other nonmetallic mining
		327992	Ground or treated mineral and earth manufacturing
50	331210		Iron and steel pipes and tubes manufacturing from purchased steel
51	331312		Primary aluminum production
52	331316		Aluminum extruded product manufacturing
53	331411		Primary smelting and refining of copper
54	331419		Primary smelting and refining of nonferrous metal

		(except copper and aluminum)
55	33151X	*331511* Iron foundries
		331512 Steel investment foundries
		331513 Steel foundries (except investment)
56	33152X	*331521* Aluminum die - casting foundries
		331524 Aluminum foundries (except die - casting)
57	33152Y	*331522* nonferrous (except aluminum) die - casting foundries
		331525 Copper foundries (except die - casting)
		331528 Other nonferrous foundries (except die - casting)
58	33211X	*332111* Iron and steel forging
		332112 nonferrous forging
59	332721	Precision turned product manufacturing
60	332991	Ball and roller bearing manufacturing
61	332992	Small arms ammunition manufacturing
62	332993	Ammunition (except small arms) manufacturing
63	332995	Other ordnance and accessories manufacturing
64	332996	Fabricated pipe and pipe fitting manufacturing
65	33313X	*333131* Mining machinery and equipment manufacturing
		333132 Oil and gas field machinery and equipment manufacturing
66	33341X	*333411* Air purification equipment manufacturing
		333412 Industrial and commercial fan and blower manufacturing
67	333512	Machine tool (metal cutting types) manufacturing
68	333513	Machine tool (metal forming types) manufacturing
69	333516	Rolling mill machinery and equipment manufacturing
70	33351X	*333511* Industrial mold manufacturing
		333514 Special die and tool, die set, jig, and fixture manufacturing
71	333611	Turbine and turbine generator set unit manufacturing
72	333612	Speed changer, industrial high - speed drive, and gear manufacturing
73	333613	Mechanical power transmission equipment manufacturing
74	333913	Measuring and dispensing pump manufacturing
75	333991	Power - driven hand tool manufacturing
76	333994	Industrial process furnace and oven manufacturing
77	334413	Semiconductor and related device manufacturing
78	334414	Electronic capacitor manufacturing
79	334415	Electronic resistor manufacturing
80	334416	Electronic coil, transformer, and other inductor manufacturing
81	334417	Electronic connector manufacturing
82	334512	Automatic environmental control manufacturing for residential, commercial, and appliance use
83	334513	Instruments and related products manufacturing for measuring, displaying, and controlling industrial process variables
84	33461A	*334612* prerecorded compact disc (except software), tape, and record reproducing
		512220 Integrated record production/distribution
85	335221	Household cooking appliance manufacturing

86	335222	Household refrigerator and home freezer manufacturing	
87	335224	Household laundry equipment manufacturing	
88	335312	motor and generator manufacturing	
89	335911	Storage battery manufacturing	
90	335912	Primary battery manufacturing	
91	335991	Carbon and graphite product manufacturing	
92	336212	Truck trailer manufacturing	
93	336370	Motor vehicle metal stamping	
94	33661A	*336611*	Ship building and repairing
		488390	Other support activities for water transportation
		336612	Boat building
		811490	Other personal and household goods repair and maintenance
95	337920	Blind and shade manufacturing	
96	339114	Dental equipment and supplies manufacturing	
97	339991	Gasket, packing, and sealing device manufacturing	
98	339992	Musical instrument manufacturing	
99	339995	Burial casket manufacturing	
100	3STXYZ	All other manufacturing including miscellaneous manufacturing	
		311211	Flour Milling
		311212	Rice Milling
		311213	Malt Manufacturing
		311230	Breakfast Cereal Manufacturing
		311320	Chocolate and Confectionery Manufacturing from cacao Beans
		311330	Confectionery Manufacturing from Purchased Chocolate
		311340	Nonchocolate Confectionery Manufacturing
	31141X	*311411*	Frozen fruit, juice, and vegetable manufacturing
		311412	Frozen specialty food manufacturing
		311421	Fruit and Vegetable Canning
		311422	Specialty Canning
		311423	Dried and Dehydrated Food Manufacturing
		311511	Fluid Milk Manufacturing
		311512	Creamery Butter Manufacturing
		311514	Dry, Condensed, and Evaporated Dairy Product Manufacturing
		311615	Poultry Processing
		311811	Retail Bakeries
		311812	Commercial Bakeries
		311813	Frozen Cakes, Pies, and Other Pastries Manufacturing
		311821	Cookie and Cracker Manufacturing
		311822	Flour Mixes and Dough Manufacturing from Purchased Flour
		311823	Dry Pasta Manufacturing
		311830	Tortilla Manufacturing
		311911	Roasted Nuts and Peanut Butter Manufacturing

311919 Other Snack Food Manufacturing
311920 Coffee and Tea Manufacturing
311930 Flavoring Syrup and Concentrate Manufacturing
311941 Mayonnaise, Dressing, and Other Prepared Sauce Manufacturing
311942 Spice and Extract Manufacturing
311991 Perishable Prepared Food Manufacturing
311999 All Other Miscellaneous Food Manufacturing
312120 Breweries
313111 Yarn Spinning Mills
313112 Yarn Texturing, Throwing, and Twisting Mills
313113 Thread Mills
313210 Broad Woven Fabric Mills
313221 Narrow Fabric Mills
313222 Schiffli Machine Embroidery
313230 Nonwoven Fabric Mills
313241 Weft Knit Fabric Mills
313249 Other Knit Fabric and Lace Mills
313311 Broad Woven Fabric Finishing Mills
313312 Textile and Fabric Finishing (except Broad Woven Fabric) Mills
313320 Fabric Coating Mills
314121 Curtain and Drapery Mills
314129 Other Household Textile Product Mills
314911 Textile Bag Mills
314912 Canvas and Related Product Mills
314991 Rope, Cordage, and Twine Mills
314999 All Other Miscellaneous Textile Product Mills
315111 Sheer Hosiery Mills
315119 Other Hosiery and Sock Mills
315191 Outerwear Knitting Mills
315192 Underwear and Nightwear Knitting Mills
315211 Men's and Boys' Cut and Sew Apparel Contractors
315212 Women's, Girls', and Infants' Cut and Sew Apparel Contractors
315221 Men's and Boys' Cut and Sew Underwear and Nightwear Manufacturing
315222 Men's and Boys' Cut and Sew Suit, Coat and Overcoat Manufacturing
315223 Men's and Boys' Cut and Sew Shirt (except Work Shirt) Manufacturing
315224 Men's and Boys' Cut and Sew Trouser, Slack and Jean Manufacturing
315225 Men's and Boys' Cut and Sew Work Clothing Manufacturing
315228 Men's and Boys' Cut and Sew Other Outerwear

Manufacturing
315231 Women’s and Girls’ Cut and Sew Lingerie, Loungewear, and Nightwear Manufacturing
315232 Women’s and Girls’ Cut and Sew Blouse and Shirt Manufacturing
315233 Women’s and Girls’ Cut and Sew Dress Manufacturing
315234 Women’s and Girls’ Cut and Sew Suit, Coat, Tailored Jacket, and Skirt Manufacturing
315239 Women’s and Girls’ Cut and Sew Other Outerwear Manufacturing
315291 Infants’ Cut and Sew Apparel Manufacturing
315292 Fur and Leather Apparel Manufacturing
315299 All Other Cut and Sew Apparel Manufacturing
315991 Hat, Cap, and Millinery Manufacturing
315992 Glove and Mitten Manufacturing
315993 Men’s and Boys’ Neckwear Manufacturing
315999 Other Apparel Accessories and Other Apparel Manufacturing
316110 Leather and Hide Tanning and Finishing
316991 Luggage Manufacturing
316992 Women's Handbag and Purse Manufacturing
316993 Personal Leather Good (except Women’s Handbag and Purse) Manufacturing
316999 All Other Leather Good Manufacturing
321113 Sawmills
321114 Wood Preservation
321219 Reconstituted Wood Product Manufacturing
321911 Wood Window and Door Manufacturing
321912 Cut Stock, Resawing Lumber, and Planking
321918 Other Millwork (including Flooring)
321920 Wood Container and Pallet Manufacturing
321920 Wood Container and Pallet Manufacturing
321999 All Other Miscellaneous Wood Product Manufacturing
322110 Pulp Mills
322121 Paper (except Newsprint) Mills
322122 Newsprint Mills
322130 Paperboard Mills
322211 Corrugated and Solid Fiber Box Manufacturing
322212 Folding Paperboard Box Manufacturing
322213 Setup Paperboard Box Manufacturing
322214 Fiber Can, Tube, Drum, and Similar Products Manufacturing
322215 Nonfolding Sanitary Food Container Manufacturing
322221 Coated and Laminated Packaging Paper and Plastics Film Manufacturing
322222 Coated and Laminated Paper Manufacturing
322223 Plastics, Foil, and Coated Paper Bag Manufacturing

322224	Uncoated Paper and Multiwall Bag Manufacturing
322225	Laminated Aluminum Foil Manufacturing for Flexible Packaging Uses
322226	Surface-Coated Paperboard Manufacturing
322231	Die-Cut Paper and Paperboard Office Supplies Manufacturing
322232	Envelope Manufacturing
322233	Stationery, Tablet, and Related Product Manufacturing
322291	Sanitary Paper Product Manufacturing
322299	All Other Converted Paper Product Manufacturing
323110	Commercial Lithographic Printing
323111	Commercial Gravure Printing
323112	Commercial Flexographic Printing
323113	Commercial Screen Printing
323114	Quick Printing
323115	Digital Printing
323116	Manifold Business Form Printing
323117	Book Printing
323118	Blank Book, Loose-leaf Binder, and Device Manufacturing
323119	Other Commercial Printing
323121	Trade Binding and Related Work
323122	Prepress Services
324110	Petroleum Refineries
324199	All Other Petroleum and Coal Products Manufacturing
325110	Petrochemical Manufacturing
325120	Industrial Gas Manufacturing
325131	Inorganic Dye and Pigment Manufacturing
325132	Synthetic Organic Dye and Pigment Manufacturing
325182	Carbon Black Manufacturing
325188	All Other Basic Inorganic Chemical Manufacturing
325191	Gum and Wood Chemical Manufacturing
325192	Cyclic Crude and Intermediate Manufacturing
325193	Ethyl Alcohol Manufacturing
325199	All Other Basic Organic Chemical Manufacturing
325414	Biological Product (except Diagnostic) Manufacturing
325510	Paint and Coating Manufacturing
325991	Custom Compounding of Purchased Resins
325992	Photographic Film, Paper, Plate, and Chemical Manufacturing
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing
326111	Plastics Bag Manufacturing
326112	Plastics Packaging Film and Sheet (including Laminated) Manufacturing
326113	Unlaminated Plastics Film and Sheet (except Packaging)

Manufacturing
326121 Unlaminated Plastics Profile Shape Manufacturing
326122 Plastics Pipe and Pipe Fitting Manufacturing
326130 Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing
326140 Polystyrene Foam Product Manufacturing
326150 Urethane and Other Foam Product (except Polystyrene) Manufacturing
326160 Plastics Bottle Manufacturing
326191 Plastics Plumbing Fixture Manufacturing
326192 Resilient Floor Covering Manufacturing
326192 Resilient Floor Covering Manufacturing
326199 All Other Plastics Product Manufacturing
326212 Tire Retreading
326291 Rubber Product Manufacturing for Mechanical Use
326299 All Other Rubber Product Manufacturing
327112 Vitreous China, Fine Earthenware, and Other Pottery Product Manufacturing
327113 Porcelain Electrical Supply Manufacturing
327121 Brick and Structural Clay Tile Manufacturing
327331 Concrete Block and Brick Manufacturing
327332 Concrete Pipe Manufacturing
327390 Other Concrete Product Manufacturing
327420 Gypsum Product Manufacturing
327420 Gypsum Product Manufacturing
327910 Abrasive Product Manufacturing
327999 All Other Miscellaneous Nonmetallic Mineral Product Manufacturing
331111 Iron and Steel Mills
331112 Electrometallurgical Ferroalloy Product Manufacturing
331221 Rolled Steel Shape Manufacturing
331222 Steel Wire Drawing
331311 Alumina Refining
331314 Secondary Smelting and Alloying of Aluminum
331315 Aluminum Sheet, Plate, and Foil Manufacturing
331319 Other Aluminum Rolling and Drawing
331421 Copper Rolling, Drawing, and Extruding
331422 Copper Wire (except Mechanical) Drawing
331423 Secondary Smelting, Refining, and Alloying of Copper
331491 Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding
331492 Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminum)
332114 Custom Roll Forming
332115 Crown and Closure Manufacturing

332116	Metal Stamping
332117	Powder Metallurgy Part Manufacturing
332211	Cutlery and Flatware (except Precious) Manufacturing
332212	Hand and Edge Tool Manufacturing
332213	Saw Blade and Handsaw Manufacturing
332214	Kitchen Utensil, Pot, and Pan Manufacturing
332311	Prefabricated Metal Building and Component Manufacturing
332312	Fabricated Structural Metal Manufacturing
332313	Plate Work Manufacturing
332321	Metal Window and Door Manufacturing
332322	Sheet Metal Work Manufacturing
332323	Ornamental and Architectural Metal Work Manufacturing
332410	Power Boiler and Heat Exchanger Manufacturing
332420	Metal Tank (Heavy Gauge) Manufacturing
332431	Metal Can Manufacturing
332439	Other Metal Container Manufacturing
332510	Hardware Manufacturing
332611	Spring (Heavy Gauge) Manufacturing
332612	Spring (Light Gauge) Manufacturing
332618	Other Fabricated Wire Product Manufacturing
332710	Machine Shops
332722	Bolt, Nut, Screw, Rivet, and Washer Manufacturing
332811	Metal Heat Treating
332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers
332813	Electroplating, Plating, Polishing, Anodizing and Coloring
332911	Industrial Valve Manufacturing
332912	Fluid Power Valve and Hose Fitting Manufacturing
332913	Plumbing Fixture Fitting and Trim Manufacturing
332919	Other Metal Valve and Pipe Fitting Manufacturing
332994	Small Arms Manufacturing
332997	Industrial Pattern Manufacturing
332998	Enameled Iron and Metal Sanitary Ware Manufacturing
332999	All Other Miscellaneous Fabricated Metal Product Manufacturing
333111	Farm Machinery and Equipment Manufacturing
333112	Lawn and Garden Tractor and Home Lawn and Garden Equipment Manufacturing
333120	Construction Machinery Manufacturing
333210	Sawmill and Woodworking Machinery Manufacturing
333220	Plastics and Rubber Industry Machinery Manufacturing
333291	Paper Industry Machinery Manufacturing
333292	Textile Machinery Manufacturing
333293	Printing Machinery and Equipment Manufacturing
333294	Food Product Machinery Manufacturing

333295 Semiconductor Machinery Manufacturing
333298 All Other Industrial Machinery Manufacturing
333311 Automatic Vending Machine Manufacturing
333312 Commercial Laundry, Dry-cleaning, and Pressing Machine Manufacturing
333313 Office Machinery Manufacturing
333314 Optical Instrument and Lens Manufacturing
333315 Photographic and Photocopying Equipment Manufacturing
333319 Other Commercial and Service Industry Machinery Manufacturing
333414 Heating Equipment (except Warm Air Furnaces) Manufacturing
333415 Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing
333515 Cutting Tool and Machine Tool Accessory Manufacturing
333518 Other Metalworking Machinery Manufacturing
333618 Other Engine Equipment Manufacturing
333911 Pump and Pumping Equipment Manufacturing
333912 Air and Gas Compressor Manufacturing
333921 Elevator and Moving Stairway Manufacturing
333922 Conveyor and Conveying Equipment Manufacturing
333923 Overhead Traveling Crane, Hoist, and Monorail System Manufacturing
333924 Industrial Truck, Tractor, Trailer, and Stacker Machinery Manufacturing
333992 Welding and Soldering Equipment Manufacturing
333993 Packaging Machinery Manufacturing
333995 Fluid Power Cylinder and Actuator Manufacturing
333996 Fluid Power Pump and Motor Manufacturing
333997 Scale and Balance (except Laboratory) Manufacturing
333999 All Other Miscellaneous General Purpose Machinery Manufacturing
334111 Electronic Computer Manufacturing
334112 Computer Storage Device Manufacturing
334113 Computer Terminal Manufacturing
334119 Other Computer Peripheral Equipment Manufacturing
334210 Telephone Apparatus Manufacturing
334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing
334290 Other Communications Equipment Manufacturing
334310 Audio and Video Equipment Manufacturing
334411 Electron Tube Manufacturing
334412 Bare Printed Circuit Board Manufacturing
334418 Printed Circuit Assembly (Electronic Assembly)

Manufacturing
334419 Other Electronic Component Manufacturing
334510 Electro Medical and Electrotherapeutic Apparatus Manufacturing
334511 Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
334514 Totalizing Fluid Meter and Counting Device Manufacturing
334515 Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals
334516 Analytical Laboratory Instrument Manufacturing
334517 Irradiation Apparatus Manufacturing
334518 Watch, Clock, and Part Manufacturing
334519 Other Measuring and Controlling Device Manufacturing
334611 Software Reproducing
334613 Magnetic and Optical Recording Media Manufacturing
335110 Electric Lamp Bulb and Part Manufacturing
335121 Residential Electric Lighting Fixture Manufacturing
335122 Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing
335129 Other Lighting Equipment Manufacturing
335211 Electric House Wares and Household Fan Manufacturing
335212 Household Vacuum Cleaner Manufacturing
335228 Other Major Household Appliance Manufacturing
335311 Power, Distribution, and Specialty Transformer Manufacturing
335313 Switchgear and Switchboard Apparatus Manufacturing
335314 Relay and Industrial Control Manufacturing
335921 Fiber Optic Cable Manufacturing
335929 Other Communication and Energy Wire Manufacturing
335931 Current-Carrying Wiring Device Manufacturing
335932 Noncurrent-Carrying Wiring Device Manufacturing
335999 All Other Miscellaneous Electrical Equipment and Component Manufacturing
336111 Automobile Manufacturing
336112 Light Truck and Utility Vehicle Manufacturing
336120 Heavy Duty Truck Manufacturing
336211 Motor Vehicle Body Manufacturing
336211 Motor Vehicle Body Manufacturing
336213 Motor Home Manufacturing
336214 Travel Trailer and Camper Manufacturing
336311 Carburetor, Piston, Piston Ring, and Valve Manufacturing
336312 Gasoline Engine and Engine Parts Manufacturing
336321 Vehicular Lighting Equipment Manufacturing
336322 Other Motor Vehicle Electrical and Electronic Equipment Manufacturing

336330	Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing
336340	Motor Vehicle Brake System Manufacturing
336350	Motor Vehicle Transmission and Power Train Parts Manufacturing
336360	Motor Vehicle Seating and Interior Trim Manufacturing
336391	Motor Vehicle Air-Conditioning Manufacturing
336399	All Other Motor Vehicle Parts Manufacturing
336411	Aircraft Manufacturing
336412	Aircraft Engine and Engine Parts Manufacturing
336413	Other Aircraft Part and Auxiliary Equipment Manufacturing
336414	Guided Missile and Space Vehicle Manufacturing
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing
336510	Railroad Rolling Stock Manufacturing
336991	Motorcycle, Bicycle, and Parts Manufacturing
336992	Military Armored Vehicle, Tank, and Tank Component Manufacturing
336999	All Other Transportation Equipment Manufacturing
337110	Wood Kitchen Cabinet and Countertop Manufacturing
337121	Upholstered Household Furniture Manufacturing
337122	Nonupholstered Wood Household Furniture Manufacturing
337124	Metal Household Furniture Manufacturing
337125	Household Furniture (except Wood and Metal) Manufacturing
337127	Institutional Furniture Manufacturing
337129	Wood Television, Radio, and Sewing Machine Cabinet Manufacturing
337211	Wood Office Furniture Manufacturing
337212	Custom Architectural Woodwork and Millwork Manufacturing
337214	Office Furniture (except Wood) Manufacturing
337215	Showcase, Partition, Shelving, and Locker Manufacturing
337910	Mattress Manufacturing
339111	Laboratory Apparatus and Furniture Manufacturing
339112	Surgical and Medical Instrument Manufacturing
339113	Surgical Appliance and Supplies Manufacturing
339115	Ophthalmic Goods Manufacturing
339116	Dental Laboratories
339911	Jewelry (except Costume) Manufacturing
339912	Silverware and Hollowware Manufacturing
339913	Jewelers' Material and Lapidary Work Manufacturing
339914	Costume Jewelry and Novelty Manufacturing
339920	Sporting and Athletic Goods Manufacturing

339931 Doll and Stuffed Toy Manufacturing
339932 Game, Toy, and Children's Vehicle Manufacturing
339941 Pen and Mechanical Pencil Manufacturing
339942 Lead Pencil and Art Good Manufacturing
339943 Marking Device Manufacturing
339944 Carbon Paper and Inked Ribbon Manufacturing
339950 Sign Manufacturing
339993 Fastener, Button, Needle, and Pin Manufacturing
339994 Broom, Brush, and Mop Manufacturing
339999 All Other Miscellaneous Manufacturing

Appendix IV: Concordance between ASM-HK and SIC72/SIC87/NAICS/ASM

(sorted by SIC 72)

SIC72	SIC87	NAICS02	ASM	ASM-HK
2011	2011	311611	31161N	311XYZ
2013	2013	311612	31161N	311XYZ
2013	2013	311613	31161N	311XYZ
2016	2015	311615	311615	3STXYZ
2016	2015	311999	31199M	3STXYZ
2017	2015	311615	311615	3STXYZ
2017	2015	311999	31199M	3STXYZ
2021	2021	311512	31151N	3STXYZ
2022	2022	311513	311513	311513
2023	2023	311514	311514	3STXYZ
2023	2023	311511	31151N	3STXYZ
2024	2024	311520	311520	311520
2026	2026	311514	311514	3STXYZ
2026	2026	311511	31151N	3STXYZ
2032	2032	311422	31142M	3STXYZ
2032	2032	311999	31199M	3STXYZ
2033	2033	311421	31142M	3STXYZ
2034	2034	311211	31121M	3STXYZ
2034	2034	311423	31142M	3STXYZ
2034	2034	311999	31199M	3STXYZ
2034	2099	111998	111998	3STXYZ
2034	2099	311340	311340	3STXYZ
2034	2099	311830	311830	3STXYZ
2034	2099	311920	311920	3STXYZ
2034	2099	311212	31121M	3STXYZ
2034	2099	311423	31142M	3STXYZ
2034	2099	311823	31182M	3STXYZ
2034	2099	311911	31191M	3STXYZ
2034	2099	311941	31194M	3STXYZ
2034	2099	311942	31194M	3STXYZ
2034	2099	311991	31199M	3STXYZ
2034	2099	311999	31199M	3STXYZ
2035	2035	311421	31142M	3STXYZ
2035	2035	311941	31194M	3STXYZ
2037	2037	311411	31141M	3STXYZ
2038	2038	311412	31141M	3STXYZ
2038	2045	311822	31182M	3STXYZ
2038	2053	311813	31181M	3STXYZ
2041	2041	311211	31121M	3STXYZ
2043	2043	311230	311230	3STXYZ
2043	2043	311920	311920	3STXYZ
2044	2044	311212	31121M	3STXYZ
2044	2099	111998	111998	3STXYZ
2044	2099	311340	311340	3STXYZ
2044	2099	311830	311830	3STXYZ
2044	2099	311920	311920	3STXYZ
2044	2099	311212	31121M	3STXYZ
2044	2099	311423	31142M	3STXYZ
2044	2099	311823	31182M	3STXYZ
2044	2099	311911	31191M	3STXYZ
2044	2099	311941	31194M	3STXYZ
2044	2099	311942	31194M	3STXYZ
2044	2099	311991	31199M	3STXYZ
2044	2099	311999	31199M	3STXYZ
2045	2045	311822	31182M	3STXYZ
2046	2046	311221	311221	31122X
2046	2046	311225	311225	31122X
2047	2047	311111	311111	311XYZ
2047	2048	311119	311119	311XYZ
2047	2048	311611	31161N	311XYZ
2048	2048	311119	311119	311XYZ
2048	2048	311611	31161N	311XYZ
2051	2051	311812	31181M	3STXYZ
2052	2052	311812	31181M	3STXYZ
2052	2052	311821	31182M	3STXYZ
2052	2052	311919	31191M	3STXYZ
2061	2061	311311	31131N	31131X
2062	2062	311312	31131N	31131X
2063	2063	311313	311313	311313
2065	2064	311330	311330	3STXYZ
2065	2064	311340	311340	3STXYZ
2065	2068	311911	31191M	3STXYZ
2066	2066	311320	311320	3STXYZ
2066	2066	311330	311330	3STXYZ
2067	2067	311340	311340	3STXYZ
2074	2074	311225	311225	31122X
2074	2074	311223	31122N	31122X
2075	2075	311225	311225	31122X
2075	2075	311222	31122N	31122X
2076	2076	311225	311225	31122X
2076	2076	311223	31122N	31122X
2077	2077	311613	31161N	311XYZ
2077	2077	311711	31171M	311XYZ
2077	2077	311712	31171M	311XYZ
2079	2079	311225	311225	31122X
2079	2079	311222	31122N	31122X
2079	2079	311223	31122N	31122X
2082	2082	312120	312120	3STXYZ
2082	2082	311942	31194M	3STXYZ
2083	2083	311213	31121M	3STXYZ
2084	2084	312130	312130	3121X0
2085	2085	312140	312140	3121X0
2085	2085	312130	312130	3121X0
2086	2086	312111	31211M	31211X

SIC72	SIC87	NAICS02	ASM	ASM-HK	SIC72	SIC87	NAICS02	ASM	ASM-HK
2086	2086	312112	31211M	31211X	2241	2241	313221	31322M	3STXYZ
2087	2087	311920	311920	3STXYZ	2251	2251	313312	31331M	3STXYZ
2087	2087	311930	311930	3STXYZ	2251	2251	315111	31511M	3STXYZ
2087	2087	311942	31194M	3STXYZ	2252	2252	313312	31331M	3STXYZ
2087	2087	311999	31199M	3STXYZ	2252	2252	315111	31511M	3STXYZ
2091	2091	311711	31171M	311XYZ	2252	2252	315119	31511M	3STXYZ
2092	2092	311712	31171M	311XYZ	2253	2253	313312	31331M	3STXYZ
2095	2095	311920	311920	3STXYZ	2253	2253	315191	31519M	3STXYZ
2097	2097	312113	31211M	31211X	2253	2253	315192	31519M	3STXYZ
2098	2098	311823	31182M	3STXYZ	2254	2254	313312	31331M	3STXYZ
2098	2099	111998	111998	3STXYZ	2254	2254	315192	31519M	3STXYZ
2098	2099	311340	311340	3STXYZ	2257	2257	313241	31324M	3STXYZ
2098	2099	311830	311830	3STXYZ	2257	2257	313312	31331M	3STXYZ
2098	2099	311920	311920	3STXYZ	2258	2258	313249	31324M	3STXYZ
2098	2099	311212	31121M	3STXYZ	2258	2258	313312	31331M	3STXYZ
2098	2099	311423	31142M	3STXYZ	2259	2259	313241	31324M	3STXYZ
2098	2099	311823	31182M	3STXYZ	2259	2259	313249	31324M	3STXYZ
2098	2099	311911	31191M	3STXYZ	2259	2259	313312	31331M	3STXYZ
2098	2099	311941	31194M	3STXYZ	2259	2259	315191	31519M	3STXYZ
2098	2099	311942	31194M	3STXYZ	2259	2259	315192	31519M	3STXYZ
2098	2099	311991	31199M	3STXYZ	2261	2261	313311	31331M	3STXYZ
2098	2099	311999	31199M	3STXYZ	2262	2262	313311	31331M	3STXYZ
2099	2026	311514	311514	3STXYZ	2269	2269	313311	31331M	3STXYZ
2099	2026	311511	31151N	3STXYZ	2269	2269	313312	31331M	3STXYZ
2099	2096	311919	31191M	3STXYZ	2271	2273	314110	314110	314110
2099	2066	311320	311320	3STXYZ	2272	2273	314110	314110	314110
2099	2066	311330	311330	3STXYZ	2279	2273	314110	314110	314110
2099	2099	111998	111998	3STXYZ	2281	2281	313111	31311M	3STXYZ
2099	2099	311340	311340	3STXYZ	2282	2282	313112	31311M	3STXYZ
2099	2099	311830	311830	3STXYZ	2283	2281	313111	31311M	3STXYZ
2099	2099	311920	311920	3STXYZ	2284	2284	313113	31311M	3STXYZ
2099	2099	311212	31121M	3STXYZ	2284	2284	313312	31331M	3STXYZ
2099	2099	311423	31142M	3STXYZ	2291	2299	313210	313210	3STXYZ
2099	2099	311823	31182M	3STXYZ	2291	2299	313230	313230	3STXYZ
2099	2099	311911	31191M	3STXYZ	2291	2299	314999	314999	3STXYZ
2099	2099	311941	31194M	3STXYZ	2291	2299	313111	31311M	3STXYZ
2099	2099	311942	31194M	3STXYZ	2291	2299	313111	31311M	3STXYZ
2099	2099	311991	31199M	3STXYZ	2291	2299	313113	31311M	3STXYZ
2099	2099	311999	31199M	3STXYZ	2291	2299	313221	31322M	3STXYZ
2111	2111	312221	31222M	3122XY	2291	2299	313312	31331M	3STXYZ
2121	2121	312229	31222M	3122XY	2292	2258	313249	31324M	3STXYZ
2131	2131	312229	31222M	3122XY	2292	2258	313312	31331M	3STXYZ
2141	2141	312210	312210	3122XY	2293	2299	313210	313210	3STXYZ
2141	2141	312229	31222M	3122XY	2293	2299	313230	313230	3STXYZ
2211	2211	313210	313210	3STXYZ	2293	2299	314999	314999	3STXYZ
2221	2221	313210	313210	3STXYZ	2293	2299	313111	31311M	3STXYZ
2231	2231	313210	313210	3STXYZ	2293	2299	313111	31311M	3STXYZ
2231	2231	313311	31331M	3STXYZ	2293	2299	313113	31311M	3STXYZ
2231	2231	313312	31331M	3STXYZ	2293	2299	313221	31322M	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
2293	2299	313312	31331M	3STXYZ
2294	2299	313210	313210	3STXYZ
2294	2299	313230	313230	3STXYZ
2294	2299	314999	314999	3STXYZ
2294	2299	313111	31311M	3STXYZ
2294	2299	313111	31311M	3STXYZ
2294	2299	313113	31311M	3STXYZ
2294	2299	313221	31322M	3STXYZ
2294	2299	313312	31331M	3STXYZ
2295	2295	313320	313320	3STXYZ
2296	2296	314992	314992	314992
2297	2297	313230	313230	3STXYZ
2298	2298	314991	314991	3STXYZ
2298	2298	313111	31311M	3STXYZ
2299	2299	313210	313210	3STXYZ
2299	2299	313230	313230	3STXYZ
2299	2299	314999	314999	3STXYZ
2299	2299	313111	31311M	3STXYZ
2299	2299	313111	31311M	3STXYZ
2299	2299	313113	31311M	3STXYZ
2299	2299	313221	31322M	3STXYZ
2299	2299	313312	31331M	3STXYZ
2311	2311	315211	31521M	3STXYZ
2311	2311	315222	31522M	3STXYZ
2321	2321	315211	31521M	3STXYZ
2321	2321	315223	31522M	3STXYZ
2321	2322	315211	31521M	3STXYZ
2321	2322	315221	31522M	3STXYZ
2322	2322	315211	31521M	3STXYZ
2322	2322	315221	31522M	3STXYZ
2323	2323	315211	31521M	3STXYZ
2323	2323	315993	31599M	3STXYZ
2327	2325	315211	31521M	3STXYZ
2327	2325	315224	31522M	3STXYZ
2327	2329	315211	31521M	3STXYZ
2327	2329	315228	31522M	3STXYZ
2327	2329	315299	31529M	3STXYZ
2328	2325	315211	31521M	3STXYZ
2328	2325	315224	31522M	3STXYZ
2328	2326	315211	31521M	3STXYZ
2328	2326	315225	31522M	3STXYZ
2329	2329	315211	31521M	3STXYZ
2329	2329	315228	31522M	3STXYZ
2329	2329	315299	31529M	3STXYZ
2331	2331	315212	31521M	3STXYZ
2331	2331	315232	31523M	3STXYZ
2335	2335	315212	31521M	3STXYZ
2335	2335	315233	31523M	3STXYZ
2337	2337	315212	31521M	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
2337	2337	315234	31523M	3STXYZ
2339	2339	315212	31521M	3STXYZ
2339	2339	315239	31523M	3STXYZ
2339	2339	315299	31529M	3STXYZ
2339	2339	315999	31599M	3STXYZ
2341	2341	315211	31521M	3STXYZ
2341	2341	315212	31521M	3STXYZ
2341	2341	315221	31522M	3STXYZ
2341	2341	315231	31523M	3STXYZ
2341	2341	315291	31529M	3STXYZ
2342	2342	315212	31521M	3STXYZ
2342	2342	315231	31523M	3STXYZ
2351	2353	315211	31521M	3STXYZ
2351	2353	315212	31521M	3STXYZ
2351	2353	315991	31599M	3STXYZ
2352	2353	315211	31521M	3STXYZ
2352	2353	315212	31521M	3STXYZ
2352	2353	315991	31599M	3STXYZ
2361	2361	315211	31521M	3STXYZ
2361	2361	315212	31521M	3STXYZ
2361	2361	315223	31522M	3STXYZ
2361	2361	315232	31523M	3STXYZ
2361	2361	315233	31523M	3STXYZ
2361	2361	315291	31529M	3STXYZ
2363	2369	315211	31521M	3STXYZ
2363	2369	315212	31521M	3STXYZ
2363	2369	315221	31522M	3STXYZ
2363	2369	315222	31522M	3STXYZ
2363	2369	315224	31522M	3STXYZ
2363	2369	315228	31522M	3STXYZ
2363	2369	315231	31523M	3STXYZ
2363	2369	315234	31523M	3STXYZ
2363	2369	315239	31523M	3STXYZ
2363	2369	315291	31529M	3STXYZ
2369	2369	315211	31521M	3STXYZ
2369	2369	315212	31521M	3STXYZ
2369	2369	315221	31522M	3STXYZ
2369	2369	315222	31522M	3STXYZ
2369	2369	315224	31522M	3STXYZ
2369	2369	315228	31522M	3STXYZ
2369	2369	315231	31523M	3STXYZ
2369	2369	315234	31523M	3STXYZ
2369	2369	315239	31523M	3STXYZ
2369	2369	315291	31529M	3STXYZ
2371	2371	315211	31521M	3STXYZ
2371	2371	315212	31521M	3STXYZ
2371	2371	315292	31529M	3STXYZ
2381	2381	315211	31521M	3STXYZ
2381	2381	315212	31521M	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
2381	2381	315992	31599M	3STXYZ
2384	2384	315211	31521M	3STXYZ
2384	2384	315212	31521M	3STXYZ
2384	2384	315221	31522M	3STXYZ
2384	2384	315231	31523M	3STXYZ
2385	2385	315211	31521M	3STXYZ
2385	2385	315212	31521M	3STXYZ
2385	2385	315222	31522M	3STXYZ
2385	2385	315228	31522M	3STXYZ
2385	2385	315234	31523M	3STXYZ
2385	2385	315239	31523M	3STXYZ
2385	2385	315291	31529M	3STXYZ
2385	2385	315299	31529M	3STXYZ
2385	2385	315999	31599M	3STXYZ
2386	2386	315211	31521M	3STXYZ
2386	2386	315212	31521M	3STXYZ
2386	2386	315292	31529M	3STXYZ
2387	2387	315211	31521M	3STXYZ
2387	2387	315212	31521M	3STXYZ
2387	2387	315999	31599M	3STXYZ
2389	2389	315211	31521M	3STXYZ
2389	2389	315212	31521M	3STXYZ
2389	2389	315231	31523M	3STXYZ
2389	2389	315299	31529M	3STXYZ
2389	2389	315999	31599M	3STXYZ
2391	2391	314121	31412M	3STXYZ
2392	2392	314999	314999	3STXYZ
2392	2392	339994	339994	3STXYZ
2392	2392	314129	31412M	3STXYZ
2392	2392	314911	31491M	3STXYZ
2393	2393	314911	31491M	3STXYZ
2394	2394	314912	31491M	3STXYZ
2395	2395	314999	314999	3STXYZ
2395	2395	315211	31521M	3STXYZ
2395	2395	315212	31521M	3STXYZ
2395	2396	314999	314999	3STXYZ
2395	2396	336360	336360	3STXYZ
2395	2396	315211	31521M	3STXYZ
2395	2396	315212	31521M	3STXYZ
2395	2396	315999	31599M	3STXYZ
2395	2396	323113	32311M	3STXYZ
2396	2396	314999	314999	3STXYZ
2396	2396	336360	336360	3STXYZ
2396	2396	315211	31521M	3STXYZ
2396	2396	315212	31521M	3STXYZ
2396	2396	315999	31599M	3STXYZ
2396	2396	323113	32311M	3STXYZ
2397	2397	313222	31322M	3STXYZ
2399	2399	314999	314999	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
2399	2399	336360	336360	3STXYZ
2399	2399	315211	31521M	3STXYZ
2399	2399	315212	31521M	3STXYZ
2399	2399	315999	31599M	3STXYZ
2411	2411	113310	113310	113310
2421	2421	321920	321920	3STXYZ
2421	2421	321999	321999	3STXYZ
2421	2421	321113	32111M	3STXYZ
2421	2421	321912	32191M	3STXYZ
2421	2421	321918	32191M	3STXYZ
2426	2426	337215	337215	3STXYZ
2426	2426	321113	32111M	3STXYZ
2426	2426	321912	32191M	3STXYZ
2426	2426	321918	32191M	3STXYZ
2429	2429	321920	321920	3STXYZ
2429	2429	321999	321999	3STXYZ
2429	2429	321113	32111M	3STXYZ
2431	2431	321911	32191M	3STXYZ
2431	2431	321918	32191M	3STXYZ
2434	2434	337110	337110	3STXYZ
2435	2435	321211	32121N	32121Y
2436	2436	321212	32121N	32121Y
2439	2439	321213	32121P	32121X
2439	2439	321214	32121P	32121X
2441	2441	321920	321920	3STXYZ
2448	2448	321920	321920	3STXYZ
2449	2449	321920	321920	3STXYZ
2451	2451	321991	321991	321991
2452	2452	321992	321992	321992
2491	2491	321114	32111M	3STXYZ
2492	2493	321219	321219	3STXYZ
2499	2493	321219	321219	3STXYZ
2499	2499	321920	321920	3STXYZ
2499	2499	321999	321999	3STXYZ
2499	2499	333415	333415	3STXYZ
2499	2499	339113	339113	3STXYZ
2499	2499	339999	339999	3STXYZ
2499	2499	337125	33712N	3STXYZ
2499	3089	326121	326121	3STXYZ
2499	3089	326122	326122	3STXYZ
2499	3089	337215	337215	3STXYZ
2499	3089	339113	339113	3STXYZ
2499	3089	326199	32619M	3STXYZ
2511	2511	337122	337122	3STXYZ
2511	2511	337215	337215	3STXYZ
2512	2512	337121	337121	3STXYZ
2514	2514	337121	337121	3STXYZ
2514	2514	337215	337215	3STXYZ
2514	2514	337124	33712N	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
2515	2515	337121	337121	3STXYZ
2515	2515	337910	337910	3STXYZ
2517	2517	337129	33712N	3STXYZ
2519	2519	337125	33712N	3STXYZ
2521	2521	337211	33721N	3STXYZ
2522	2522	337214	33721N	3STXYZ
2531	2531	336360	336360	3STXYZ
2531	2531	337127	337127	3STXYZ
2531	2531	339942	33994M	3STXYZ
2541	2541	337110	337110	3STXYZ
2541	2541	337127	337127	3STXYZ
2541	2541	337212	337212	3STXYZ
2541	2541	337215	337215	3STXYZ
2542	2542	337127	337127	3STXYZ
2542	2542	337215	337215	3STXYZ
2591	2591	337920	337920	337920
2599	2599	337127	337127	3STXYZ
2599	2599	339111	339111	3STXYZ
2611	2611	322110	322110	3STXYZ
2611	2611	322130	322130	3STXYZ
2611	2611	322121	32212M	3STXYZ
2611	2611	322122	32212M	3STXYZ
2621	2621	322121	32212M	3STXYZ
2621	2621	322122	32212M	3STXYZ
2631	2631	322130	322130	3STXYZ
2641	2671	326112	326112	3STXYZ
2641	2671	322221	32222N	3STXYZ
2641	2672	322222	32222N	3STXYZ
2642	2677	322232	32223M	3STXYZ
2643	2673	326111	326111	3STXYZ
2643	2673	322223	32222P	3STXYZ
2643	2674	322224	32222P	3STXYZ
2645	2675	322299	322299	3STXYZ
2645	2675	322226	32222P	3STXYZ
2645	2675	322231	32223M	3STXYZ
2646	2679	322231	32223M	3STXYZ
2646	2679	322299	322299	3STXYZ
2646	2679	322211	32221M	3STXYZ
2646	2679	322222	32222N	3STXYZ
2647	2676	322291	322291	3STXYZ
2648	2678	322233	32223M	3STXYZ
2649	2679	322299	322299	3STXYZ
2649	2679	322211	32221M	3STXYZ
2649	2679	322222	32222N	3STXYZ
2649	2679	322231	32223M	3STXYZ
2651	2657	322212	32221M	3STXYZ
2652	2652	322213	32221M	3STXYZ
2653	2653	322211	32221M	3STXYZ
2654	2656	322215	32221M	3STXYZ
2654	2657	322212	32221M	3STXYZ
2655	2655	322214	32221M	3STXYZ
2661	2493	321219	321219	3STXYZ
2661	2621	322121	32212M	3STXYZ
2661	2621	322122	32212M	3STXYZ
2711	2711	511110	511110	3STXYZ
2711	2711	516110	516110	3STXYZ
2721	2721	511120	511120	3STXYZ
2721	2721	516110	516110	3STXYZ
2731	2731	511130	511130	3STXYZ
2731	2731	512230	512230	3STXYZ
2731	2731	516110	516110	3STXYZ
2732	2732	323117	32311M	3STXYZ
2741	2741	511120	511120	3STXYZ
2741	2741	511130	511130	3STXYZ
2741	2741	511140	511140	3STXYZ
2741	2741	511199	511199	3STXYZ
2741	2741	512230	512230	3STXYZ
2741	2741	516110	516110	3STXYZ
2751	2759	323112	32311M	3STXYZ
2751	2759	323113	32311M	3STXYZ
2751	2759	323114	32311M	3STXYZ
2751	2759	323115	32311M	3STXYZ
2751	2759	323119	32311M	3STXYZ
2752	2752	323110	32311M	3STXYZ
2752	2752	323114	32311M	3STXYZ
2753	2759	323112	32311M	3STXYZ
2753	2759	323113	32311M	3STXYZ
2753	2759	323114	32311M	3STXYZ
2753	2759	323115	32311M	3STXYZ
2753	2759	323119	32311M	3STXYZ
2753	2796	323122	32312M	3STXYZ
2754	2754	323111	32311M	3STXYZ
2754	2796	323122	32312M	3STXYZ
2761	2761	323116	32311M	3STXYZ
2771	2771	511191	511191	3STXYZ
2771	2771	516110	516110	3STXYZ
2771	2771	323110	32311M	3STXYZ
2771	2771	323111	32311M	3STXYZ
2771	2771	323112	32311M	3STXYZ
2771	2771	323113	32311M	3STXYZ
2771	2771	323119	32311M	3STXYZ
2782	2782	323116	32311M	3STXYZ
2782	2782	323118	32311M	3STXYZ
2789	2789	323121	32312M	3STXYZ
2791	2791	323122	32312M	3STXYZ
2793	2796	323122	32312M	3STXYZ
2794	2796	323122	32312M	3STXYZ
2795	2796	323122	32312M	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
2812	2812	325181	325181	325181
2813	2813	325120	325120	3STXYZ
2816	2816	325182	325182	3STXYZ
2816	2816	325131	32513M	3STXYZ
2819	2819	211112	211112	3STXYZ
2819	2819	325188	325188	3STXYZ
2819	2819	331311	331311	3STXYZ
2819	2819	325131	32513M	3STXYZ
2819	2819	325998	32599N	3STXYZ
2821	2821	325211	325211	325211
2822	2822	325212	325212	325212
2823	2823	325221	32522M	32522X
2824	2824	325222	32522M	32522X
2831	2835	325412	325412	32541X
2831	2835	325413	325413	32541X
2831	2836	325414	325414	32541X
2833	2833	325411	325411	325411
2834	2834	325412	325412	32541X
2841	2841	325611	32561M	3256XY
2842	2842	325612	32561M	3256XY
2843	2843	325613	32561M	3256XY
2844	2844	325620	325620	3256XY
2844	2844	325611	32561M	3256XY
2851	2851	325510	325510	3STXYZ
2861	2861	325191	32519M	3STXYZ
2865	2865	325110	325110	3STXYZ
2865	2865	325132	32513M	3STXYZ
2865	2865	325192	32519M	3STXYZ
2869	2869	325110	325110	3STXYZ
2869	2869	325120	325120	3STXYZ
2869	2869	325188	325188	3STXYZ
2869	2869	325192	32519M	3STXYZ
2869	2869	325193	32519M	3STXYZ
2869	2869	325199	32519M	3STXYZ
2869	2869	325998	32599N	3STXYZ
2873	2873	325311	325311	325311
2874	2874	325312	325312	325312
2875	2875	325314	325314	325314
2879	2879	325320	325320	325320
2891	2891	325520	325520	325520
2892	2892	325920	325920	325920
2893	2893	325910	325910	325910
2895	2895	325182	325182	3STXYZ
2899	2899	325510	325510	3STXYZ
2899	2899	311942	31194M	3STXYZ
2899	2899	325199	32519M	3STXYZ
2899	2899	325998	32599N	3STXYZ
2911	2865	325110	325110	3STXYZ
2911	2865	325132	32513M	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
2911	2865	325192	32519M	3STXYZ
2911	2869	325110	325110	3STXYZ
2911	2869	325120	325120	3STXYZ
2911	2869	325188	325188	3STXYZ
2911	2869	325192	32519M	3STXYZ
2911	2869	325193	32519M	3STXYZ
2911	2869	325199	32519M	3STXYZ
2911	2869	325998	32599N	3STXYZ
2911	2911	324110	324110	3STXYZ
2911	2999	324199	324199	3STXYZ
2951	2951	324121	324121	32412X
2952	2952	324122	324122	32412X
2992	2992	324191	324191	324191
2999	2999	324199	324199	3STXYZ
3011	3011	326211	32621M	326211
3021	3021	316211	31621M	31621X
3031	3069	313320	313320	3STXYZ
3031	3069	339113	339113	3STXYZ
3031	3069	339920	339920	3STXYZ
3031	3069	314911	31491M	3STXYZ
3031	3069	315299	31529M	3STXYZ
3031	3069	315999	31599M	3STXYZ
3031	3069	326192	32619M	3STXYZ
3031	3069	326299	32629M	3STXYZ
3031	3069	339932	33993M	3STXYZ
3041	3052	326220	326220	326220
3069	3061	326291	32629M	3STXYZ
3069	3069	313320	313320	3STXYZ
3069	3069	339113	339113	3STXYZ
3069	3069	339920	339920	3STXYZ
3069	3069	314911	31491M	3STXYZ
3069	3069	315299	31529M	3STXYZ
3069	3069	315999	31599M	3STXYZ
3069	3069	326192	32619M	3STXYZ
3069	3069	326299	32629M	3STXYZ
3069	3069	339932	33993M	3STXYZ
3079	3081	326113	326113	3STXYZ
3079	3082	326121	326121	3STXYZ
3079	3083	326130	326130	3STXYZ
3079	3084	326122	326122	3STXYZ
3079	3085	326160	326160	3STXYZ
3079	3086	326140	326140	3STXYZ
3079	3086	326150	326150	3STXYZ
3079	3087	325991	325991	3STXYZ
3079	3088	326191	32619M	3STXYZ
3079	3089	326121	326121	3STXYZ
3079	3089	326122	326122	3STXYZ
3079	3089	337215	337215	3STXYZ
3079	3089	339113	339113	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK	SIC72	SIC87	NAICS02	ASM	ASM-HK
3079	3089	326199	32619M	3STXYZ	3295	3295	212399	212399	32799A
3111	3111	316110	316110	3STXYZ	3295	3295	327992	327992	32799A
3131	3131	321999	321999	3STXYZ	3296	3296	327993	327993	327993
3131	3131	339993	339993	3STXYZ	3297	3297	327125	32712N	32712X
3131	3131	316999	31699M	3STXYZ	3299	3299	327420	327420	3STXYZ
3142	3142	316212	31621M	31621X	3299	3299	327999	327999	3STXYZ
3143	3143	316213	31621M	31621X	3299	3299	327112	327112	3STXYZ
3144	3144	316214	31621M	31621X	3312	3312	324199	324199	3STXYZ
3149	3149	316219	31621M	31621X	3312	3312	331111	33111M	3STXYZ
3151	3151	315211	31521M	3STXYZ	3312	3312	331221	33122M	3STXYZ
3151	3151	315212	31521M	3STXYZ	3313	3313	331112	33111M	3STXYZ
3151	3151	315992	31599M	3STXYZ	3315	3315	331222	33122M	3STXYZ
3161	3161	316991	31699M	3STXYZ	3315	3315	332618	33261M	3STXYZ
3171	3171	316992	31699M	3STXYZ	3316	3316	331221	33122M	3STXYZ
3172	3172	316993	31699M	3STXYZ	3317	3317	331210	331210	331210
3172	3172	339914	33991M	3STXYZ	3321	3321	331511	33151M	33151X
3199	3199	316999	31699M	3STXYZ	3322	3322	331511	33151M	33151X
3211	3211	327211	327211	327211	3324	3324	331512	33151M	33151X
3221	3221	327213	327213	327213	3325	3325	331513	33151M	33151X
3229	3229	327212	327212	327212	3331	3331	331411	331411	331411
3231	3231	327215	327215	327215	3332	3339	331419	331419	331419
3241	3241	327310	327310	327310	3333	3339	331419	331419	331419
3251	3251	327121	327121	3STXYZ	3334	3334	331312	331312	331312
3251	3251	327331	32733M	3STXYZ	3339	3339	331419	331419	331419
3253	3253	327122	327122	327122	3341	3341	331314	331314	3STXYZ
3255	3255	327124	32712N	32712X	3341	3341	331423	33142M	3STXYZ
3259	3259	327123	327123	327123	3341	3341	331492	33149M	3STXYZ
3261	3261	327111	327111	327111	3351	3351	331421	33142M	3STXYZ
3262	3262	327112	327112	3STXYZ	3353	3353	331315	33131N	3STXYZ
3263	3263	327112	327112	3STXYZ	3354	3354	331316	331316	331316
3264	3264	327113	327113	3STXYZ	3355	3355	331319	33131N	3STXYZ
3269	3269	327112	327112	3STXYZ	3356	3356	331491	33149M	3STXYZ
3271	3271	327331	32733M	3STXYZ	3357	3357	331319	33131N	3STXYZ
3272	3272	327390	327390	3STXYZ	3357	3357	331422	33142M	3STXYZ
3272	3272	327999	327999	3STXYZ	3357	3357	331491	33149M	3STXYZ
3272	3272	327332	32733M	3STXYZ	3357	3357	335921	33592M	3STXYZ
3273	3273	327320	327320	327320	3357	3357	335929	33592M	3STXYZ
3274	3274	327410	327410	327410	3361	3363	331521	33152N	33152X
3275	3275	327420	327420	3STXYZ	3361	3365	331524	33152N	33152X
3281	3281	327991	327991	327991	3362	3364	331522	33152P	33152Y
3291	3291	327910	327910	3STXYZ	3362	3366	331525	33152P	33152Y
3291	3291	332999	33299N	3STXYZ	3369	3364	331522	33152P	33152Y
3292	3292	327999	327999	3STXYZ	3369	3369	331528	33152P	33152Y
3292	3292	336340	336340	3STXYZ	3398	3398	332811	33281M	3STXYZ
3292	3292	336350	336350	3STXYZ	3399	3399	331314	331314	3STXYZ
3293	3053	339991	339991	339991	3399	3399	331111	33111M	3STXYZ
3295	3295	212324	212324	32799A	3399	3399	331221	33122M	3STXYZ
3295	3295	212325	212325	32799A	3399	3399	331423	33142M	3STXYZ
3295	3295	212393	212393	32799A	3399	3399	331492	33149M	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
3399	3399	332618	33261M	3STXYZ
3399	3399	332813	33281M	3STXYZ
3411	3411	332431	33243M	3STXYZ
3412	3412	332439	33243M	3STXYZ
3421	3421	332211	33221N	3STXYZ
3421	3421	332212	33221P	3STXYZ
3423	3423	332212	33221P	3STXYZ
3425	3425	332213	33221P	3STXYZ
3429	3429	332510	332510	3STXYZ
3429	3429	332722	332722	3STXYZ
3429	3429	334518	334518	3STXYZ
3429	3429	336399	336399	3STXYZ
3429	3429	337215	337215	3STXYZ
3429	3429	332439	33243M	3STXYZ
3429	3429	332919	33291N	3STXYZ
3429	3429	332999	33299N	3STXYZ
3429	3429	333923	33392M	3STXYZ
3431	3431	332998	33299N	3STXYZ
3432	3432	332913	332913	3STXYZ
3432	3432	332919	33291N	3STXYZ
3432	3432	332999	33299N	3STXYZ
3433	3433	333414	333414	3STXYZ
3441	3441	332312	33231M	3STXYZ
3442	3442	332321	33232M	3STXYZ
3443	3443	332313	33231M	3STXYZ
3443	3443	332410	332410	3STXYZ
3443	3443	332420	332420	3STXYZ
3443	3443	333415	333415	3STXYZ
3444	3444	333415	333415	3STXYZ
3444	3444	332321	33232M	3STXYZ
3444	3444	332322	33232M	3STXYZ
3444	3444	332439	33243M	3STXYZ
3446	3446	332323	33232M	3STXYZ
3448	3448	332311	33231M	3STXYZ
3449	3449	332114	332114	3STXYZ
3449	3449	332312	33231M	3STXYZ
3449	3449	332323	33232M	3STXYZ
3451	3451	332721	332721	332721
3452	3452	332722	332722	3STXYZ
3462	3462	332111	33211N	33211X
3463	3463	332112	33211N	33211X
3465	3465	336370	336370	336370
3466	3466	332115	33211P	3STXYZ
3469	3469	332116	33211P	3STXYZ
3469	3469	332214	33221N	3STXYZ
3469	3469	332439	33243M	3STXYZ
3471	3471	332813	33281M	3STXYZ
3479	3479	332812	33281M	3STXYZ
3479	3479	339911	33991M	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
3479	3479	339912	33991M	3STXYZ
3479	3479	339914	33991M	3STXYZ
3482	3482	332992	332992	332992
3483	3483	332993	332993	332993
3484	3484	332994	332994	3STXYZ
3489	3489	332995	332995	332995
3493	3493	332611	33261M	3STXYZ
3494	3491	332911	33291N	3STXYZ
3494	3492	332912	33291N	3STXYZ
3494	3494	332919	33291N	3STXYZ
3494	3494	332999	33299N	3STXYZ
3495	3495	334518	334518	3STXYZ
3495	3495	332612	33261M	3STXYZ
3496	3496	332214	33221N	3STXYZ
3496	3496	332618	33261M	3STXYZ
3496	3496	333924	33392M	3STXYZ
3497	3497	322225	32222P	3STXYZ
3497	3497	332999	33299N	3STXYZ
3498	3498	332996	332996	332996
3499	3499	332117	332117	3STXYZ
3499	3499	332510	332510	3STXYZ
3499	3499	336360	336360	3STXYZ
3499	3499	337215	337215	3STXYZ
3499	3499	332439	33243M	3STXYZ
3499	3499	332919	33291N	3STXYZ
3499	3499	332999	33299N	3STXYZ
3511	3511	333611	333611	333611
3519	3519	333618	333618	3STXYZ
3519	3519	336399	336399	3STXYZ
3523	3523	333111	333111	3STXYZ
3523	3523	332212	33221P	3STXYZ
3523	3523	332323	33232M	3STXYZ
3523	3523	333922	33392M	3STXYZ
3524	3524	333112	333112	3STXYZ
3524	3524	332212	33221P	3STXYZ
3531	3531	333120	333120	3STXYZ
3531	3531	336510	336510	3STXYZ
3531	3531	333923	33392M	3STXYZ
3532	3532	333131	33313M	33313X
3533	3533	333132	33313M	33313X
3534	3534	333921	33392M	3STXYZ
3535	3535	333922	33392M	3STXYZ
3536	3537	332999	33299N	3STXYZ
3536	3537	333924	33392M	3STXYZ
3536	3531	333120	333120	3STXYZ
3536	3531	336510	336510	3STXYZ
3536	3531	333923	33392M	3STXYZ
3536	3536	333923	33392M	3STXYZ
3536	3537	332439	33243M	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
3537	3537	332439	33243M	3STXYZ
3537	3537	332999	33299N	3STXYZ
3537	3537	333924	33392M	3STXYZ
3537	3531	333120	333120	3STXYZ
3537	3531	336510	336510	3STXYZ
3537	3531	333923	33392M	3STXYZ
3541	3541	333512	333512	333512
3542	3542	333513	333513	333513
3544	3544	333511	333511	33351X
3544	3544	333514	333514	33351X
3545	3545	333515	333515	3STXYZ
3545	3545	332212	33221P	3STXYZ
3546	3546	333991	333991	333991
3547	3547	333516	333516	333516
3549	3548	335311	335311	3STXYZ
3549	3548	333992	33399P	3STXYZ
3549	3549	333518	333518	3STXYZ
3549	3559	332410	332410	3STXYZ
3549	3559	333111	333111	3STXYZ
3549	3559	333220	333220	3STXYZ
3549	3559	333295	333295	3STXYZ
3549	3559	333298	33329N	3STXYZ
3549	3559	333319	33331N	3STXYZ
3549	3699	333618	333618	3STXYZ
3549	3699	335999	335999	3STXYZ
3549	3699	333319	33331N	3STXYZ
3549	3699	333992	33399P	3STXYZ
3549	3699	335129	33512M	3STXYZ
3551	3556	333294	33329N	3STXYZ
3551	3565	333993	333993	3STXYZ
3552	3552	333292	33329N	3STXYZ
3553	3553	333210	333210	3STXYZ
3553	3423	332212	33221P	3STXYZ
3554	3554	333291	33329N	3STXYZ
3555	3555	333293	33329N	3STXYZ
3555	3069	313320	313320	3STXYZ
3555	3069	339113	339113	3STXYZ
3555	3069	339920	339920	3STXYZ
3555	3069	314911	31491M	3STXYZ
3555	3069	315299	31529M	3STXYZ
3555	3069	315999	31599M	3STXYZ
3555	3069	326192	32619M	3STXYZ
3555	3069	326299	32629M	3STXYZ
3555	3069	339932	33993M	3STXYZ
3559	3559	332410	332410	3STXYZ
3559	3559	333111	333111	3STXYZ
3559	3559	333220	333220	3STXYZ
3559	3559	333295	333295	3STXYZ
3559	3559	333298	33329N	3STXYZ
3559	3559	333319	33331N	3STXYZ
3561	3594	333996	33399N	3STXYZ
3561	3561	333911	333911	3STXYZ
3562	3562	332991	332991	332991
3563	3594	333996	33399N	3STXYZ
3563	3563	333912	333912	3STXYZ
3564	3564	333411	33341N	33341X
3564	3564	333412	33341N	33341X
3565	3543	332997	33299N	3STXYZ
3566	3566	333612	333612	333612
3567	3567	333994	333994	333994
3568	3568	333613	333613	333613
3569	3565	333993	333993	3STXYZ
3569	3569	314999	314999	3STXYZ
3569	3569	333414	333414	3STXYZ
3569	3569	333999	33399P	3STXYZ
3573	3695	334613	334613	3STXYZ
3573	3571	334111	334111	3STXYZ
3573	3572	334112	334112	3STXYZ
3573	3575	334113	334113	3STXYZ
3573	3577	334119	334119	3STXYZ
3573	3577	334418	334418	3STXYZ
3573	3577	334613	334613	3STXYZ
3573	3661	334210	334210	3STXYZ
3573	3661	334418	334418	3STXYZ
3574	3578	333313	333313	3STXYZ
3574	3578	334119	334119	3STXYZ
3574	3578	333311	33331N	3STXYZ
3576	3596	333997	33399P	3STXYZ
3579	3579	333313	333313	3STXYZ
3579	3579	334518	334518	3STXYZ
3579	3579	339942	33994M	3STXYZ
3581	3581	333311	33331N	3STXYZ
3582	3582	333312	33331N	3STXYZ
3585	3585	333415	333415	3STXYZ
3585	3585	336391	336391	3STXYZ
3586	3586	333913	333913	333913
3589	3589	333319	33331N	3STXYZ
3592	3592	336311	33631M	3STXYZ
3599	3593	333995	33399N	3STXYZ
3599	3599	332710	332710	3STXYZ
3599	3599	334519	334519	3STXYZ
3599	3599	336399	336399	3STXYZ
3599	3599	332813	33281M	3STXYZ
3599	3599	332999	33299N	3STXYZ
3599	3599	333319	33331N	3STXYZ
3599	3599	333999	33399P	3STXYZ
3612	3612	335311	335311	3STXYZ
3613	3613	335313	335313	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
3613	3625	335314	335314	3STXYZ
3621	3621	335312	335312	335312
3622	3625	335314	335314	3STXYZ
3623	3548	335311	335311	3STXYZ
3623	3548	333992	33399P	3STXYZ
3624	3624	335991	335991	335991
3629	3629	335999	335999	3STXYZ
3631	3631	335221	335221	335221
3632	3632	335222	335222	335222
3633	3633	335224	335224	335224
3634	3634	333414	333414	3STXYZ
3634	3634	339999	339999	3STXYZ
3634	3634	335211	33521M	3STXYZ
3635	3635	335212	33521M	3STXYZ
3636	3599	332710	332710	3STXYZ
3636	3599	334519	334519	3STXYZ
3636	3599	336399	336399	3STXYZ
3636	3599	332813	33281M	3STXYZ
3636	3599	332999	33299N	3STXYZ
3636	3599	333319	33331N	3STXYZ
3636	3599	333999	33399P	3STXYZ
3636	3639	335228	335228	3STXYZ
3636	3639	333298	33329N	3STXYZ
3636	3639	335212	33521M	3STXYZ
3639	3639	335228	335228	3STXYZ
3639	3639	333298	33329N	3STXYZ
3639	3639	335212	33521M	3STXYZ
3641	3641	335110	335110	3STXYZ
3643	3643	335931	33593M	3STXYZ
3644	3644	332212	33221P	3STXYZ
3644	3644	335932	33593M	3STXYZ
3645	3645	335121	33512M	3STXYZ
3646	3646	335122	33512M	3STXYZ
3647	3647	336321	33632M	3STXYZ
3648	3648	335129	33512M	3STXYZ
3651	3651	334310	334310	3STXYZ
3652	3652	334612	334612	33461A
3652	3652	512220	512220	33461A
3661	3575	334113	334113	3STXYZ
3661	3661	334210	334210	3STXYZ
3661	3661	334418	334418	3STXYZ
3662	3699	333618	333618	3STXYZ
3662	3699	335999	335999	3STXYZ
3662	3699	333319	33331N	3STXYZ
3662	3699	333992	33399P	3STXYZ
3662	3699	335129	33512M	3STXYZ
3662	3829	334514	334514	3STXYZ
3662	3829	334518	334518	3STXYZ
3662	3829	334519	334519	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
3662	3829	339112	339112	3STXYZ
3662	3571	334111	334111	3STXYZ
3662	3661	334210	334210	3STXYZ
3662	3661	334418	334418	3STXYZ
3662	3663	334220	334220	3STXYZ
3662	3669	334290	334290	3STXYZ
3662	3679	334220	334220	3STXYZ
3662	3679	334310	334310	3STXYZ
3662	3679	334418	334418	3STXYZ
3662	3679	334419	334419	3STXYZ
3662	3812	334511	334511	3STXYZ
3671	3671	334411	334411	3STXYZ
3674	3674	334413	334413	334413
3675	3675	334414	334414	334414
3676	3676	334415	334415	334415
3677	3677	334416	334416	334416
3678	3678	334417	334417	334417
3679	3625	335314	335314	3STXYZ
3679	3679	334310	334310	3STXYZ
3679	3679	334418	334418	3STXYZ
3679	3679	334419	334419	3STXYZ
3679	3695	334613	334613	3STXYZ
3679	3264	327113	327113	3STXYZ
3679	3671	334411	334411	3STXYZ
3679	3672	334412	334412	3STXYZ
3679	3679	334220	334220	3STXYZ
3691	3691	335911	335911	335911
3692	3692	335912	335912	335912
3693	3844	334517	334517	3STXYZ
3693	3845	334510	334510	3STXYZ
3693	3845	334517	334517	3STXYZ
3694	3694	336322	33632M	3STXYZ
3699	3699	333618	333618	3STXYZ
3699	3699	335999	335999	3STXYZ
3699	3699	333319	33331N	3STXYZ
3699	3699	333992	33399P	3STXYZ
3699	3699	335129	33512M	3STXYZ
3699	3585	333415	333415	3STXYZ
3699	3585	336391	336391	3STXYZ
3699	3641	335110	335110	3STXYZ
3711	3711	336111	336111	3STXYZ
3711	3711	336112	336112	3STXYZ
3711	3711	336120	336120	3STXYZ
3711	3711	336211	336211	3STXYZ
3711	3711	336992	336992	3STXYZ
3713	3713	336211	336211	3STXYZ
3713	3716	336213	336213	3STXYZ
3714	3714	336211	336211	3STXYZ
3714	3714	336330	336330	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
3714	3714	336340	336340	3STXYZ
3714	3714	336350	336350	3STXYZ
3714	3714	336399	336399	3STXYZ
3714	3714	336312	33631M	3STXYZ
3714	3714	336322	33632M	3STXYZ
3715	3715	336212	336212	336212
3721	3721	336411	336411	3STXYZ
3721	3721	541710	541710	3STXYZ
3724	3724	336412	336412	3STXYZ
3724	3724	541710	541710	3STXYZ
3728	3728	336411	336411	3STXYZ
3728	3728	336413	336413	3STXYZ
3728	3728	541710	541710	3STXYZ
3728	3728	332912	33291N	3STXYZ
3731	3731	336611	336611	33661A
3731	3731	488390	488390	33661A
3732	3732	336612	336612	33661A
3732	3732	811490	811490	33661A
3743	3743	333911	333911	3STXYZ
3743	3743	336510	336510	3STXYZ
3751	3751	336991	336991	3STXYZ
3761	3761	336414	336414	3STXYZ
3761	3761	541710	541710	3STXYZ
3764	3764	336415	336415	3STXYZ
3764	3764	541710	541710	3STXYZ
3769	3769	336419	336419	3STXYZ
3769	3769	541710	541710	3STXYZ
3792	3792	336214	336214	3STXYZ
3795	3795	336992	336992	3STXYZ
3799	3799	336214	336214	3STXYZ
3799	3799	336399	336399	3STXYZ
3799	3799	336999	336999	3STXYZ
3799	3799	333924	33392M	3STXYZ
3811	3826	334516	334516	3STXYZ
3811	3829	334514	334514	3STXYZ
3811	3829	334518	334518	3STXYZ
3811	3829	334519	334519	3STXYZ
3811	3829	339112	339112	3STXYZ
3811	3812	334511	334511	3STXYZ
3811	3821	339111	339111	3STXYZ
3822	3822	334512	334512	334512
3823	3823	334513	334513	334513
3824	3824	334514	334514	3STXYZ
3825	3825	334515	334515	3STXYZ
3825	3825	334514	334514	3STXYZ
3829	3829	334514	334514	3STXYZ
3829	3829	334518	334518	3STXYZ
3829	3829	334519	334519	3STXYZ
3829	3829	339112	339112	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
3832	3826	334516	334516	3STXYZ
3832	3827	333314	333314	3STXYZ
3832	3829	334514	334514	3STXYZ
3832	3829	334518	334518	3STXYZ
3832	3829	334519	334519	3STXYZ
3832	3829	339112	339112	3STXYZ
3841	3841	332994	332994	3STXYZ
3841	3841	339111	339111	3STXYZ
3841	3841	339112	339112	3STXYZ
3842	3842	322291	322291	3STXYZ
3842	3842	334510	334510	3STXYZ
3842	3842	339113	339113	3STXYZ
3842	3842	339999	339999	3STXYZ
3843	3843	339114	339114	339114
3851	3851	339113	339113	3STXYZ
3851	3851	339115	339115	3STXYZ
3861	3861	333315	333315	3STXYZ
3861	3861	325992	32599N	3STXYZ
3873	3873	334518	334518	3STXYZ
3911	3911	339911	33991M	3STXYZ
3914	3914	332211	33221N	3STXYZ
3914	3914	332999	33299N	3STXYZ
3914	3914	339912	33991M	3STXYZ
3915	3915	334518	334518	3STXYZ
3915	3915	339913	33991M	3STXYZ
3931	3931	339992	339992	339992
3942	3942	339931	33993M	3STXYZ
3944	3944	336991	336991	3STXYZ
3944	3944	339932	33993M	3STXYZ
3949	3949	339920	339920	3STXYZ
3951	3951	339941	33994M	3STXYZ
3952	3952	337127	337127	3STXYZ
3952	3952	325998	32599N	3STXYZ
3952	3952	339942	33994M	3STXYZ
3953	3953	339943	33994M	3STXYZ
3955	3955	339944	33994M	3STXYZ
3961	3961	339993	339993	3STXYZ
3961	3961	339914	33991M	3STXYZ
3962	3999	333319	33331N	3STXYZ
3962	3999	335121	33512M	3STXYZ
3962	3999	335211	33521M	3STXYZ
3962	3999	339932	33993M	3STXYZ
3962	3999	316110	316110	3STXYZ
3962	3999	321999	321999	3STXYZ
3962	3999	337127	337127	3STXYZ
3962	3999	339999	339999	3STXYZ
3962	3999	325998	32599N	3STXYZ
3962	3999	326199	32619M	3STXYZ
3962	3999	332211	33221N	3STXYZ

SIC72	SIC87	NAICS02	ASM	ASM-HK
3962	3999	332212	33221P	3STXYZ
3962	3999	332812	33281M	3STXYZ
3962	3999	332999	33299N	3STXYZ
3963	3965	339993	339993	3STXYZ
3964	3965	339993	339993	3STXYZ
3991	3991	339994	339994	3STXYZ
3993	3993	339950	339950	3STXYZ
3993	3993	323113	32311M	3STXYZ
3995	3995	339995	339995	339995
3996	3996	326192	32619M	3STXYZ
3999	3999	316110	316110	3STXYZ
3999	3999	321999	321999	3STXYZ
3999	3999	337127	337127	3STXYZ
3999	3999	339999	339999	3STXYZ
3999	3999	325998	32599N	3STXYZ
3999	3999	326199	32619M	3STXYZ
3999	3999	332211	33221N	3STXYZ
3999	3999	332212	33221P	3STXYZ
3999	3999	332812	33281M	3STXYZ
3999	3999	332999	33299N	3STXYZ
3999	3999	333319	33331N	3STXYZ
3999	3999	335121	33512M	3STXYZ
3999	3999	335211	33521M	3STXYZ
3999	3999	339932	33993M	3STXYZ

Appendix V: Missing values

There are several cases I have faced when I have tried to make up these missing values as follows (all cases below are examples):

- Case – 1:

3-digit SIC	amount		4-digit SIC	amount
242	490.2	→	2421	456.4
		→	2426	22.0
		→	2429	??? (missing)
			Total:	490.2

Missing value in 2429 is remainder (11.8) of SIC code-242.

- Case – 2:

3-digit SIC	amount		4-digit SIC	amount
225	9.9	→	2251	???
		→	2252	2.7
		→	2253	5.5
		→	2259	???
			Total:	9.9

Summation of missing values in 2251 and 2259 are 1.7 as a remainder of SIC code-225.

In this case, how to divide 1.7 into 2251 and 2259 respectively is a question. If both 2251 and 2259 are replaced with the same code number of ASM-HK code, I place 1.7 in 2251 and 0 in 2259 since 2251 and 2259 are aggregated in ASM-HK code. If 2251 and 2259 are replaced with different code number in ASM-HK respectively, there is no way to divide 1.7 into two industry codes. In this case, I keep both values blank.

- Case – 3:

2-digit SIC	amount		3-digit SIC	amount
26	268.8	→	261	???
		→	262	64.6
		→	263	???
		→	265	93.2
		→	267	84.5
			Total:	268.8

Summation of missing values of 261 and 263 are 26.5 as a remainder of SIC code-26. Then,

3-digit SIC	amount		4-digit SIC	amount
261		→	2611	???
		→	2612	1.5
263		→	2631	???
		→	2635	9.2
		→	2637	???
			Total:	26.5

If 2611, 2631, and 2637 are replaced with the same code number in ASM-HK, I place 26.5 in 2611 and 0 in both 2631 and 2637 since 2611, 2631, and 2637 are aggregated in ASM-HK. If 2611 and 2611, 2631, and 2637 can not be replaced with the same code number in ASM-HK, I keep values in 2611, 2631, and 2637 blank.

Appendix VI: Derivation of the equation (16)

Let $i = 1,......., I$ be factors of production and $j = 1,......., J$ be commodities. From zero profit condition, we have;

$$p_j = \sum_{i=1}^{I} a_{ij} w_i \,,$$

where, $a_{ij} (= \frac{\partial c_j(w_i)}{\partial w_i})$ is input requirement to produce one unit of commodity j.

Total differentiation of the above gives us: $dp_j = \sum_{i=1}^{I} da_{ij} w_i + \sum_{i=1}^{I} a_{ij} dw_i$

Dividing both sides by $c_j (= p_j)$ and manipulating a little algebra to get

$$\hat{p}_j = \sum_{i=1}^{I} \theta_{ij} \hat{a}_{ij} + \sum_{i=1}^{I} \theta_{ij} \hat{w}_i \qquad j = 1,......., J \qquad \text{(A-6)}$$

where, $\theta_{ij} = \frac{a_{ij} w_i}{c_j}$, which is factor share of unit cost and $\hat{p}_j = \frac{dp_j}{p_j} = d \log p_j$ from Jones algebra (Jones 1965).

Consider $\hat{a}_{ij}$.

<u>Case for constant returns to scale</u>

Suppose first, technology has constant returns to scale. In this case, a_{ij} depends on ratio of factor prices such that $a_{ij} = a_{ij}(\omega_{ik})$, where $\omega_{ik} = \frac{w_i}{w_k}$, for $i \neq k$, $i, k = 1,......., I$. Since every firm minimizes unit cost of (A-VI-1), solving this firm's minimization problem gives $\sum_{i=1}^{I} da_{ij} w_i + \sum_{i=1}^{I} a_{ij} dw_i = 0$.

Since firm treats factor prices fixed, that is, $\sum_{i=1}^{I} a_{ij} dw_i = 0$, we get $\sum_{i=1}^{I} da_{ij} w_i = 0$.

Dividing both sides by p_j yields $\quad \sum_{i=1}^{I} \theta_{ij} \hat{a}_{ij} = 0 \qquad$ (A-7)

Second, the difference between $\hat{a}_{ij}$ and $\hat{a}_{kj}$ $(i \neq k)$ is linked to the change in the factor price ratio, $\hat{\omega}_{ik}$, by the elasticity of substitution $\sigma_{ik,j}$. So, $\hat{a}_{ij} - \hat{a}_{kj} = \sigma_{ik,j} \hat{\omega}_{ik}$

When $i = 1$, $\hat{a}_{1j} - \hat{a}_{2j} = \sigma_{12,j} \hat{\omega}_{12} \quad ==> \quad \hat{a}_{1j} = \hat{a}_{2j} + \sigma_{12,j} \hat{\omega}_{12}$

$$\downarrow$$

$$\hat{a}_{1j} - \hat{a}_{Ij} = \sigma_{1I,j} \hat{\omega}_{1I} \quad ==> \quad \hat{a}_{1j} = \hat{a}_{Ij} + \sigma_{1I,j} \hat{\omega}_{1I}$$

When $i = 2$, $\hat{a}_{2j} - \hat{a}_{3j} = \sigma_{23,j} \hat{\omega}_{23} \quad ==> \quad \hat{a}_{2j} = \hat{a}_{3j} + \sigma_{23,j} \hat{\omega}_{23}$

$$\downarrow$$

$$\hat{a}_{2j} - \hat{a}_{Ij} = \sigma_{2I,j} \hat{\omega}_{2I} \quad ==> \quad \hat{a}_{2j} = \hat{a}_{Ij} + \sigma_{2I,j} \hat{\omega}_{2I} \qquad \text{(A-8)}$$

Similarly for $i = 3, \ldots\ldots, I-1$, and

When $i = I$, $\hat{a}_{1j} - \hat{a}_{Ij} = \sigma_{1I,j} \hat{\omega}_{1I} \quad ==> \quad \hat{a}_{Ij} = \hat{a}_{1j} - \sigma_{1I,j} \hat{\omega}_{1I}$

$$\downarrow$$

$$\hat{a}_{(I-1)j} - \hat{a}_{Ij} = \sigma_{(I-1)I,j} \hat{\omega}_{(I-1)I} \quad ==> \quad \hat{a}_{Ij} = \hat{a}_{(I-1)j} - \sigma_{(I-1)I,j} \hat{\omega}_{(I-1)I}$$

Next, recall $\sum_{i=1}^{I} \theta_{ij} \hat{a}_{ij} = 0 \qquad$ (A-7)

We need to solve (A-7) for $\hat{a}_{ij}$ one by one for $i = 1, \ldots\ldots, I$ using (A-8).

For $\hat{a}_{1j}$, $\theta_{1j} \hat{a}_{1j} + \theta_{2j} (\hat{a}_{1j} - \sigma_{12,j} \hat{\omega}_{12}) + \theta_{3j} (\hat{a}_{1j} - \sigma_{13,j} \hat{\omega}_{13}) + \ldots\ldots\ldots + \theta_{Ij} (\hat{a}_{1j} - \sigma_{1I,j} \hat{\omega}_{1I}) = 0$

$$\hat{a}_{1j} = \theta_{2j}\sigma_{12,j}\hat{\omega}_{12} + \theta_{3j}\sigma_{13,j}\hat{\omega}_{13} + ...+ \theta_{Ij}\sigma_{1I,j}\hat{\omega}_{1I} \quad (\text{since } \sum_{i=1}^{I}\theta_{ij} = 1)$$

Similarly, $\hat{a}_{2j} = -\theta_{1j}\sigma_{12,j}\hat{\omega}_{12} + \theta_{3j}\sigma_{23,j}\hat{\omega}_{23} + ...+ \theta_{Ij}\sigma_{2I,j}\hat{\omega}_{2I}$ (A-9)

$$\downarrow$$

$$\hat{a}_{(I-1)j} = -\theta_{1j}\sigma_{1(I-1),j}\hat{\omega}_{1(I-1)} - \theta_{2j}\sigma_{2(I-1),j}\hat{\omega}_{2(I-2)} - ....$$

$$...........- \theta_{(I-2)j}\sigma_{(I-2)(I-1),j}\hat{\omega}_{(I-2)(I-1)} + \theta_{Ij}\sigma_{I(I-1),j}\hat{\omega}_{(I-1)I}$$

$$\hat{a}_{Ij} = -\sum_{i=1}^{I-1}\theta_{ij}\sigma_{iI,j}\hat{\omega}_{iI}$$

Case for variable returns to scale

Now, we incorporate variable returns to scale into the model. In this case, a_{ij} depends on ratio of factor prices and the level of industry output X_j such that;

$$a_{ij} = a_{ij}(\omega_{ik}, X_j), \text{ where } \omega_{ik} = \frac{w_i}{w_k}, \text{ for } i \neq k,\ i,k = 1,.......,I \quad \text{(A-10)}$$

Total differentiation of (A-10) yields $da_{ij} = \sum_{i=1}^{I}(\frac{\partial a_{ij}}{\partial \omega_{ik}})d\omega_{ik} + \sum_{i=1}^{I}(\frac{\partial a_{ij}}{\partial X_j})dX_j$

Dividing both sides by a_{ij} and doing a small algebra gives;

$$\hat{a}_{ij} = \sum_{i=1}^{I}\frac{1}{a_{ij}}(\frac{\partial a_{ij}}{\partial \omega_{ik}})d\omega_{ik} + \sum_{i=1}^{I}(\frac{\partial a_{ij}}{\partial X_j})(\frac{X_j}{a_{ij}})(\frac{dX_j}{X_j}) \quad \text{(A-11)}$$

As you see, the first term on right hand side of (A-11) is $\hat{a}_{ij}$ when there is constant returns to scale. So, (A-11) will be rewritten as

$$\hat{a}_{ij} = \sum_{i=1}^{I}\hat{a}_{ij}(\text{for the case of constant returns to scale}) + R_{ij}\hat{X}_j \quad ,$$

where $R_{ij} = \dfrac{\partial a_{ij}}{\partial X_j}\dfrac{X_j}{a_{ij}}$

Next, we need to get $\hat{a}_{ij}$ one by one using (A-9) for $i = 1,......., I$.

For $\hat{a}_{1j}$, $\hat{a}_{1j} = \theta_{2j}\sigma_{12,j}\hat{\omega}_{12} + \theta_{3j}\sigma_{13,j}\hat{\omega}_{13} + ... + \theta_{Ij}\sigma_{1I,j}\hat{\omega}_{1I} + R_{1j}\hat{X}_j$

Similarly,

$$\hat{a}_{2j} = -\theta_{1j}\sigma_{12,j}\hat{\omega}_{12} + \theta_{3j}\sigma_{23,j}\hat{\omega}_{23} + ... + \theta_{Ij}\sigma_{2I,j}\hat{\omega}_{2I} + R_{2j}\hat{X}_j$$

$$\downarrow \qquad \text{(A-12)}$$

$$\hat{a}_{(I-1)j} = -\theta_{1j}\sigma_{1(I-1),j}\hat{\omega}_{1(I-1)} - \theta_{2j}\sigma_{2(I-1),j}\hat{\omega}_{2(I-2)} - .... - \theta_{(I-2)j}\sigma_{(I-2)(I-1),j}\hat{\omega}_{(I-2)(I-1)}$$

$$+\theta_{Ij}\sigma_{I(I-1),j}\hat{\omega}_{(I-1)I} + R_{(I-1)j}\hat{X}_j$$

$$\hat{a}_{Ij} = -\sum_{i=1}^{I-1}\theta_{ij}\sigma_{iI,j}\hat{\omega}_{iI} + R_{Ij}\hat{X}_j$$

We plug (A-12) into (A-6) to finally get equation (16);

$$\hat{p}_j = \sum_{i=1}^{I}\theta_{ij}\hat{w}_i + R_j\hat{X}_j, \qquad j = 1,......., J,$$

where, $R_{ij} = \dfrac{\partial a_{ij}}{\partial X_j}\dfrac{X_j}{a_{ij}}$ measures variable returns to scale

$R_j = \theta_{1j}R_{1j} + \theta_{2j}R_{2j} + ... + \theta_{(I-1)j}R_{(I-1)j} + \theta_{Ij}R_{Ij}$,

$R_j < 0$; increasing returns to scale

$R_j = 0$: constant returns to scale

$R_j > 0$: decreasing returns to scale

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